The MINOS Environmental and Magnet Power Supply controls. Description and Manuals.

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• Introduction

In the Sudan MINOS cavern, the atmospheric temperature, pressure, humidity as well as radon gas levels are being monitored and logged. The North and South magnet power supplies can also being remotely controlled and their status monitored. Lastly, the temperature on selected places of the detector steel and phototubes is monitored via thermocouples.
In this document, first, we present the instruments we use, their location, along with assembly and wiring diagrams. Next, describe the related software configuration. More specifically, we show how to configure the Fieldpoint Explorer, an OPC server from National Instruments, to access and monitor our Fieldpoint based setup. For more details on the data monitoring, logging and display software the reader is referred to References 1 and 2. Instrument manuals are also included.

• Instrumentation

Novalynx Relative Humidity and Temperature sensor. (**www.novalynx.com**)
Model **225-050Y.** Temperature ratings -40 to +60 C, accuracy 0.5%. Relative humidity (RH) 0-100%, accuracy +-3%. Supply voltage +12Vdc. Output signals 0-1Vdc.

Omega barometric pressure transducer. (**www.omega.com**)
Model **PX2760-20A5V**. Pressure ratings 0-1034mm-Hg. Excitation: 12Vdc. Output signal 0-5Vdc.

Acopian power supplies. (**www.acopian.com**)
Model **A12TN110**. Output +12Vdc, current 1 Amp.
Model **A5TN110**. Output +5Vdc, current 1 Amp.

Aware Radon Monitor with fan. Model **RM-80**.(**www.aw-el.com**)

National Instruments **Fieldpoint** distributed I/O system. (**www.ni.com**)
Ethernet controller, model **FP-1600**.
Analog Input (ADC), model **FP-AI-110**.
Pulse counter, model **FP-CTR-502**.
Thermocouple readout, model **FP-TC-120**.
Relay, model **FP-RLY-420**.

Analog output (DAC), model **FP-AO-210**.
Screw Terminal Base , model **FP-TB-1**.
Isothermal, screw Terminal Base for thermocouples, model **FP-TB-3**.
PS-4 Power Supply, 24 VDC, Universal Power Input.
DIN Rail (26 inches) for mounting Fieldpoint modules.
Fieldpoint **Bus Extender** cable.

• Location

There are two Fieldpoint readout clusters in the MINOS Far (Soudan) cavern. Each cluster is located on a rack, next to the North/South magnet power supply. Its function is to collect data from a set of environmental detectors (radon monitor, temperature-humidity probe, and a barometric pressure probe) as well as to monitor and remotely control the magnet's two power supplies.
The two racks hosting the Fieldpoint setups are located on the first level of the MINOS cavern, each next to the power supply it monitors. Both North and South pressure transducers are mounted on the respective Fieldpoint rack.
The same holds for two Acopian power supplies, a +12V DC one providing operating voltage to the transducers, and a +5V DC one, being used to monitor the status of magnet power supply switches (as will be described below).
The North temperature/humidity transducer is located on the ground floor near the Fieldpoint rack, mounted under a cable tray. The South temperature/humidity transducer is located on the first level, attached under a cable tray, in front of the South Side of the MINOS detector.
The South Radon Geiger counter is located on the ground floor, immediately next to the respective Fieldpoint rack. The North Radon counter is located on the third level, mounted on the rails close to the MINOS detector, directly above the Fieldpoint rack.
Figure 1 shows a sketch of the MINOS hall and the location of the environmental monitors.

• Assembly

The environmental detectors are not protected from miscabling and/or over-voltages. Caution is necessary for the correct assembly and wiring before applying any bias voltage.

Figure 6 shows the Fieldpoint module layout in order they appear in the actual setup.

The first Fieldpoint module of the setup, an FP-AI-110 Analog Input module, is devoted to the readout of the environmental parameters in the cavern as well as the magnet's power supply current and voltage. The environmental probes yield an analog voltage proportional to the parameter they monitor. They are factory calibrated and the readout voltage can easily be converted into temperature, humidity or barometric pressure.
The first channel of the module is reading the ambient temperature, the second the relative humidity and the third the barometric pressure. Readings are in Volts and they

are converted into physical quantities by the data logging and monitoring software. More information regarding the specifications, operation and cabling of the environmental detectors is written in the manuals appearing at the end of this document.
Figure 2 presents a wiring diagram for the two environmental transducers.
The 12 Vdc, required for the operation of these two environmental detectors is provided by a separate power supply (Acopian A12TN110) connected directly to the V an C terminals of the Fieldpoint ADC module. These terminals are reserved specifically for such purpose, that is, for external voltages required for the operation of the monitored detectors. The fourth channel of the FP-AI-110 reads an analog signal proportional to the magnet's power supply current and the fifth channel reads a signal proportional to the magnet's power supply voltage.
Figure 7 presents a detailed wiring diagram of Module 1. Explanation of the Fieldpoint FP-AI-110 channel numbering can be found in the corresponding National Instuments manual for that type of module.

The second module of the Fieldpoint setup is an FP-CTR-502 counter that reads counts from the radon monitor at channel 2.
The Radon detector is intended by the manufacturer to be connected to a PC via the 9-pin RS-232 port. The detector is getting the required operating DC voltage via the serial port. Every time an ionization signal is registered, a 50 m sec digital pulse is sent to the PC via the Ring Indicator pin of the serial port. Vendor specific software registers these pulses and presents radon related information.
In order to incorporate the detector into our Fieldpoint based setup, we connected it to the FP-CTR-502 counter. In order to do this, we interfaced the detector to the Fieldpoint counter via our own, custom made, cable, that matches the RS-232 connector from the detector's side to the Vin and COM terminals of the Fieldpoint counter.
Figure 3 presents an equivalent circuit of the radon detector and the Fieldpoint counter. The Radon Geiger counter is depicted, at the right side of figure 3, as a solid-state switch that closes (via an internally generated pulse), every time ionization is registered. That switch is connected to the Fieldpoint counter via the Vin and COM counter inputs. Vin is held at +12 Vdc by the external Acopian power supply and COM is held at ground. When the switch is open, the photodiode inside the counter is held at +12 Volts since no current is passing through. When a pulse is registered, the switch is closed for 50 m sec, current is passing through the photodiode (and the solid state switch), and the voltage across the photodiode drops to a value depending on the internal resistances in the Fieldpoint counter and Radon detector. Thus, the state of the photodiode changes for 50 m sec, and then resets itself to its old state. The counter is incremented by one when a low to high transition is sensed.
Figure 4 explains the wiring involved in interfacing the radon detector (depicted as a transistor switch in figure 3) to the Fieldpoint counter. A telephone cable from the radon monitor is connected to a female RS-232 connector, which is in turn meant to be connected into one of the serial ports on the back of the PC. The female RS-232 connector and the telephone cable are provided with the detector from the company (Aware electronics). The left part of figure 4 shows how the pins of that female RS-232 connector are associated with the solid state switch model of the Radon monitor shown at figure 3. In order to interface the device to the Fieldpoint FP-CTR-502 counter we used a

new male RS-232 connector and a coaxial cable. The right side of figure 4 shows how the wiring was done inside that male RS-232 connector. The male RS-232 connector was attached to the female one from the radon detector and the two wires at the other end of the coaxial cable were connected to the Vin and COM inputs of the Fieldpoint counter. With this setup shown in figure 4 we implemented the diagram depicted in figure 3.
In order to minimize noise from the Radon Geiger counter being radiated to the environment or propagating itself along the cable to the Fieldpoint counter we took two measures. First, the radon detector was enclosed inside an aluminum minibox with a hole big enough for the detector's sensitive window to be exposed to the environment. Second, the cable from the Radon Geiger detector to the Fieldpoint counter was wound on an 8 turn 1.5" ferrite core.
Figure 8 presents a detailed wiring diagram of Module 2. Explanation of the Fieldpoint FP-CTR-502 channel numbering can be found in the corresponding National Instuments manual for that type of module. The required +12V DC voltage is provided to module 2 by cascading the voltage from module 1 via wires connecting the V and C terminals.
The Radon detector can be used either as a standalone Geiger counter, or in conjunction with a Fan-Filter combination. A sponge filter is placed between a fan and the detector's active window. The fan is constantly running and environmental dust is collected in the filter. Radon daughters cling themselves on dust particles in the air and thus a large concentration of them appears in the filter in front of the detector's active window enhancing the counting rate. When equilibrium is reached (between one or two hours after the fan is turned on), the number of daughters decaying is equal to the number collected in the filter and the counting rate is constant. According to feedback from Canadian mines that used the RM-80 radon monitor with the fan-filter combination to measure radon levels, 1 pCi radon per liter of air generated 120 to 240 counts per minute (CPM) when equilibrium was reached. These numbers are provided by Aware Electronics (see also radon monitor manual accompanying this writeup). For Radon monitoring in the Suadan mine we are currently using the fan-filter combination and for normalizing the Counts Per Minute into pCi radon per liter of air, an arbitrary selected "average" calibration factor 180 CPM for each pCi of radon per air liter. However since we are dependent on the dust concentration (and the radon daughters captured by it) in the air to estimate the radon content, the calibration factor might depend on ventilation or activities affecting dust concentration in the cavern. Therefore empirical calibration of the fan-filter combination via a 2-4 day Radon-Test kit and re-evaluation of the calibration parameter connecting the counts per minute with the radon gas concentration in the air is necessary. Aware Electronics sells and analyses such Radon test kits.
Aware Electronics recommends that the filter, in the fan-filter combination, is changed and cleaned every 6 months.
We have tested connections of the RM-80 radon monitor to the Fieldpoint counter via coaxial cable up to a maximum cable length of 500 feet, with no problem.

The third Fieldpoint module is an FP-AO-210 analog output (DAC). The (computer controlled) analog signal from Channel 1 is used to set the magnet's power supply current. Figure 9 presents a detailed wiring diagram of Module 3. Explanation of the Fieldpoint FP-AO-210 channel numbering can be found in the corresponding National Instuments manual for that type of module.

The fourth Fieldpoint module is an FP-AI-110 ADC. It is being used exclusively to monitor the status of the magnet's power supply. An Acopian A5TN110 +5Vdc power supply is connected to the V and C terminals of the module. So, at every channel the voltage between the Vsup and COM terminals is +5 volts. Also, a 10K resistance is connected across every channel's Vin and COM terminals. Then, the terminals Vin and Vsup were connected to a switch internal to the magnet's power supply. The voltage between the Vin and COM terminals (measured directly by the Fieldpoint unit) is an indicator of the status of the switch being monitored. If the switch is open, current is not flowing and Vin is grounded (reading is 0 volts). If the switch is closed and current is flowing, the terminals Vin and Vsup are connected and Vin is at +5 Volts. A schematic representation of the circuit is shown at Figure 5.
The various channels of that module correspond to the following STATUS signals.

Channel 1: DC ON
Channel 2: READY
Channel 3: REMOTE/LOCAL
Channel 4: INTERNAL/EXTERNAL REFERENCE
Channel 5: I/V REGULATION
Channel 6: POLARITY STATUS
Channel 7: REMOTE/LOCAL STATUS

In the South setup a 1.0K Resistor is connected (in series to the 5 volts power supply) between the +5 volts terminal of the power supply and the C terminal of the Fieldpoint unit. This means that the actual voltage readout from the Fieldpoint unit when the switch inside the magnet's power supply is closed, is 5 volts minus the voltage drop on that 1.0K Resistor. If a number of switches on that module are closed, that voltage drop might be considerable since the the 10 K Resistors from Vin to COM (ground) are connected in parallel.
Figure 10 presents a detailed wiring diagram of Module 4. Explanation of the Fieldpoint FP-AI-110 channel numbering can be found in the corresponding National Instuments manual for that type of module.

The fifth Fieldpoint module is an FP-RLY-420 relay module used to remotely open or close switches controlling the following functions of the magnet's power supply.

Channel 1: ON
Channel 2: OFF
Channel 3: RESET
Channel 4: REVERSING SWITCH
Channel 5: BDOT

Figure 11 presents a detailed wiring diagram of Module 5. Explanation of the Fieldpoint FP-RLY-420 channel numbering can be found in the corresponding National Instuments manual for that type of module.

The last four Fieldpoint modules are FP-TC-120 thermocouple readout units monitoring

the 29 thermocouples, placed at various magnet positions.
Figures 12,13 and 14 show the pin wiring of the 38,12 and 8 pin connectors interfacing the cables from the magnet power supply and Bdot box, to the wires from the fieldpoint modules. These connectors are attached on a panel, part of the magnet power supply monitor and control setup.

• Data logging and Control Software.

Readout is via the **Fieldpoint Explorer** an OPC server provided free of charge from National Instruments with every purchase of a Fieldpoint Ethernet Controller. For data logging an analysis every commercial OPC client could be sufficient. Currently, we are using the National Instruments **DataSocket** ActiveX control, which is part of the software suit **Measurement Studio**. This, data logging, control and display software has already been described in references 1 and 2. In this document we will only describe how to configure the Fieldpoint Explorer and how to create the configuration file.

The discussion assumes that an IP address has been assigned to the Fieldpoint Ethernet module FP-1600, and the user either wants to connect the Fieldpoint Explorer to that Ethernet Module and create a new configuration file for automatic convenient reconnection, or he wants to re-open an old configuration file. The whole process is shown pictorially in Figure 15.
For further detailed information on the FP-1600 controller and assigning IP addresses to it one may refer in the national Instrument's homepage www.ni.com/products.

1. Double click the Fieldpoint explorer icon and under **File** choose **New**. On the left side of the window you can see **+ IA server with OPC appearing**. Expand by clicking the + sign.

2. Right click the **Fieldpoint** and choose: **add a comm resource to the server**. A GUI will pop asking for Fieldpoint information.

3. Choose Ethernet (instead of RS-232) from the appropriate menu.

4. Enter the IP address of the FP-1600 controller at the Ethernet address box that pops up. One can also make use of the **Find Devices** or **Browse** buttons, instead of manually entering the IP address.

5. If the search is successful the message **IAK operation successful** appears as well as a **+FP Res** item under the Fieldpoint one, on the left side of the original Fieldpoint Explorer window. By expanding the + sign, a list of all the Fieldpoint modules appears. By expanding any of these modules (by clicking the + sign of the module), a list of all the module's channels appears. By selecting (left click) any of the Fieldpoint modules, a list of all the module's channels appears on the right side of the Fieldpoint Explorer window.

6. Click the **Start Monitoring** button (the one with the right pointing arrow). On the right side of the window the current value of each of Fieldpoint modules appears, updating itself periodically. The monitoring process can be terminated, by clicking the **Stop Monitoring** button (the one with the square on it).

7. Save the configuration file. Under **File** choose **Save As**. The file is saved with the extension **.iak**. The next time one opens the Fieldpoint Explorer instead of opening a new file, opens the old saved **.iak** and finds the old configuration.

• Accompanying manuals.

1. NOVALYNX model 225-050Y Relative Humidity and Temperature sensor.
2. OMEGA PX2760 pressure transducer manual
3. Aware RM-80 Radon monitor.
4. Acopian Low Voltage DC power supplies.

No hardcopy Fieldpoint manuals are included with this note. They are available online at the National Instrument address www.ni.com/products.

• References

1. Documentation of Environmental Monitor program. H. Ping.
NuMI-NOTE-FD_DOCS-0869
2. Documentation of Magnet Control/Monitor program. H. Ping.
NuMI-NOTE-FD_DOCS-0870

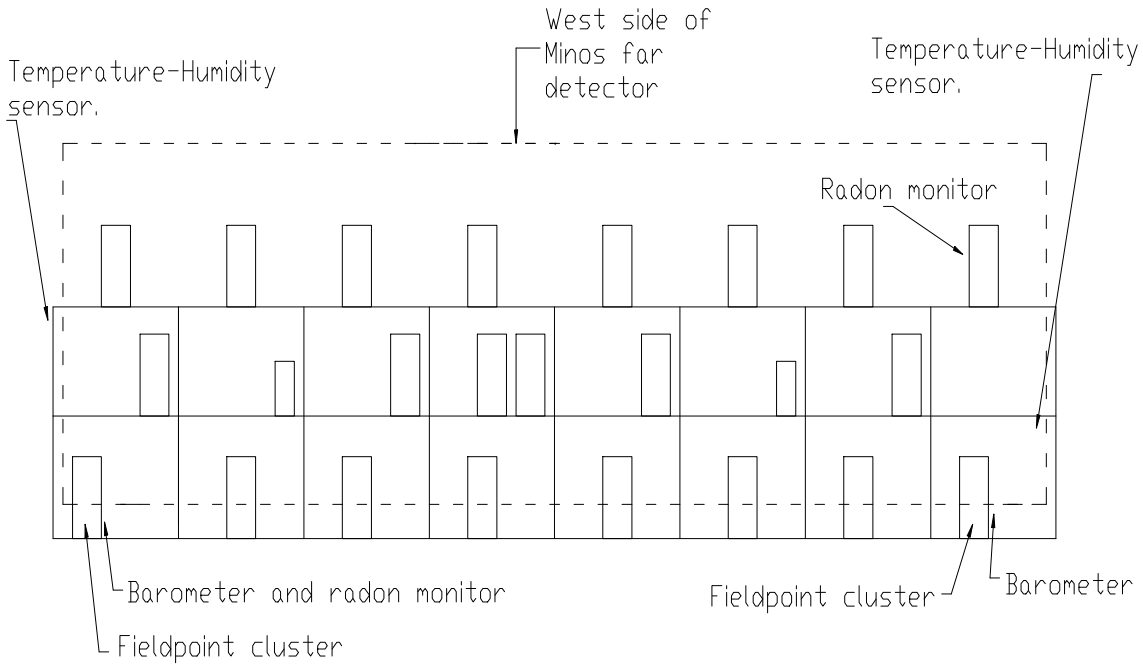


Figure 1. Location of the Environmental probes and Fieldpoint data acquisition units in the MINOS Soudan cavern.

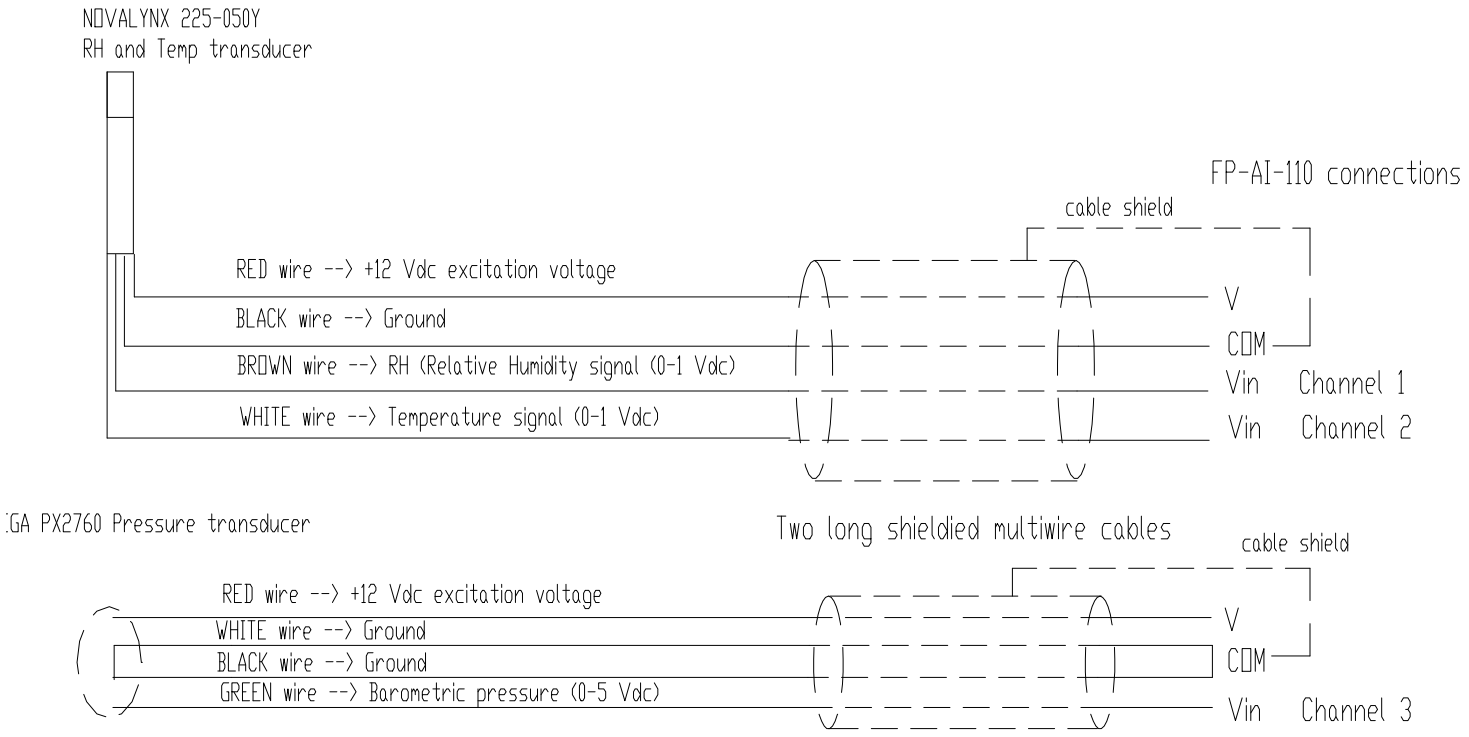


Figure 2. Cabling connections of the environmental transducers with the Fieldpoint ADC.

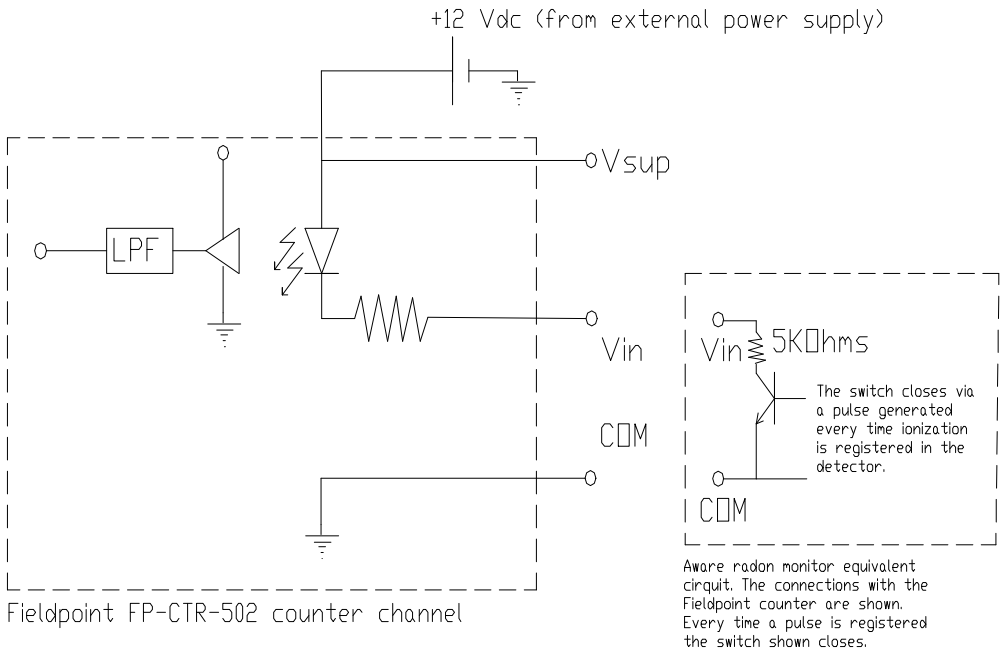
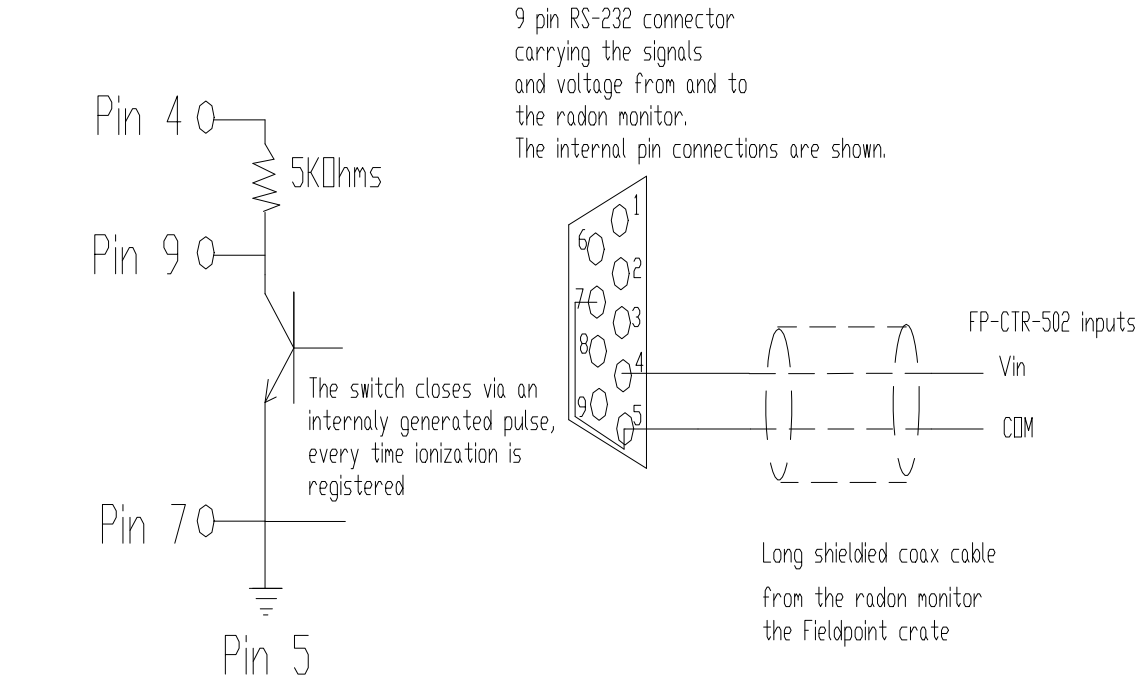


Figure 3. Aware Radon Geiger counter, and Fieldpoint FP-CTR-502 counter equivalent circuits. The radon counter (right) is depicted as a solid state switch that closes for 50 m sec every time a pulse is registered. The Radon monitor is connected to the Fieldpoint counter (left) via the Vin and COM terminals. When the switch is open the photodiode is held at 12 Vdc. When the switch is closed current passes through the photodiode, its voltage drops, it changes state and the counter increments itself by one.



Aware radon monitor equivalent cirquit. The RS-232 pin assignments are shown. The 9 pin RS-232 connector at the output of the Aware radon monitor, and its FP-CTR-502 connection is drawn.

Figure 4. The Aware Radon monitor RS-232 connector pin assignments are shown in the left part of the picture. In the right part the custom made cable to interface the radon monitor to the Fieldpoint counter is sketched. In order to be interfaced to the Fieldpoint counter only pins 4 and 5 are involved. Pin 4 is connected to Fieldpoint Vin and pin 5 to COM.

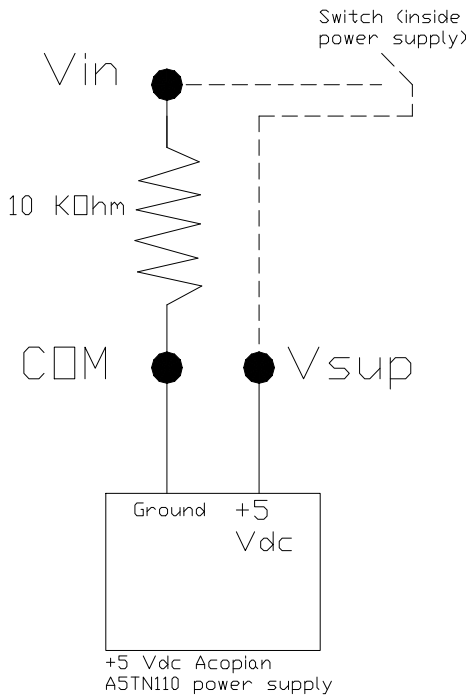


Figure 5. Monitoring the STATUS of the Magnet's Power Supply via the +5 V readout of a DC power supply. When the Switch is closed Vin (the input of the Fieldpoint ADC) is held at +5 Volts. Alternatively, when the switch is open it is held at ground (COM).

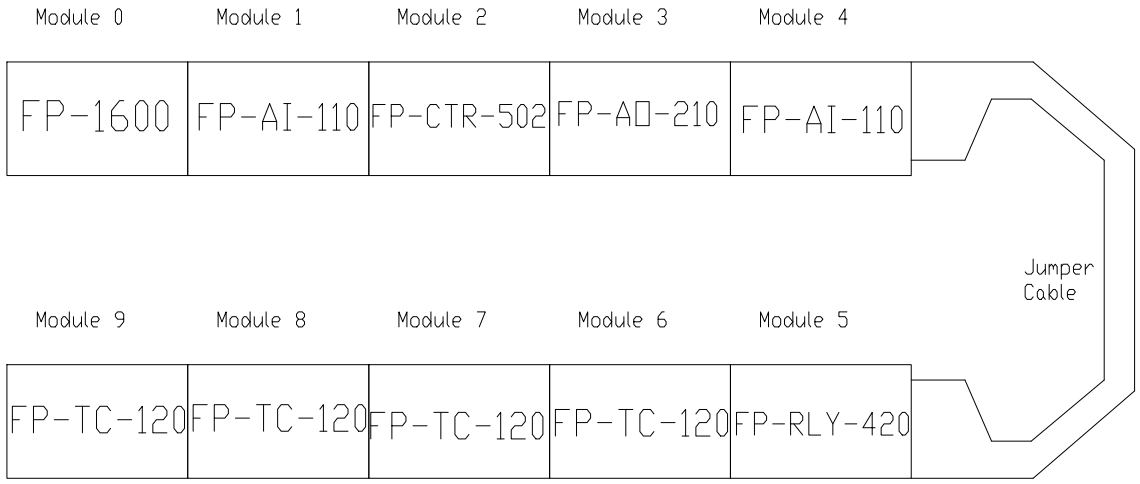


Figure 6. Fieldpoint setup layout.

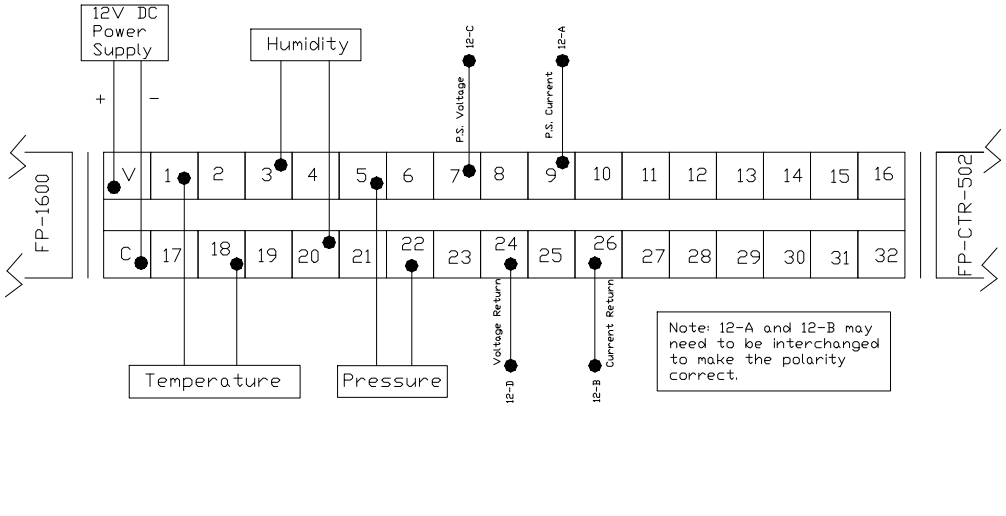


Figure 7. Wiring diagram of Fieldpoint module 1.

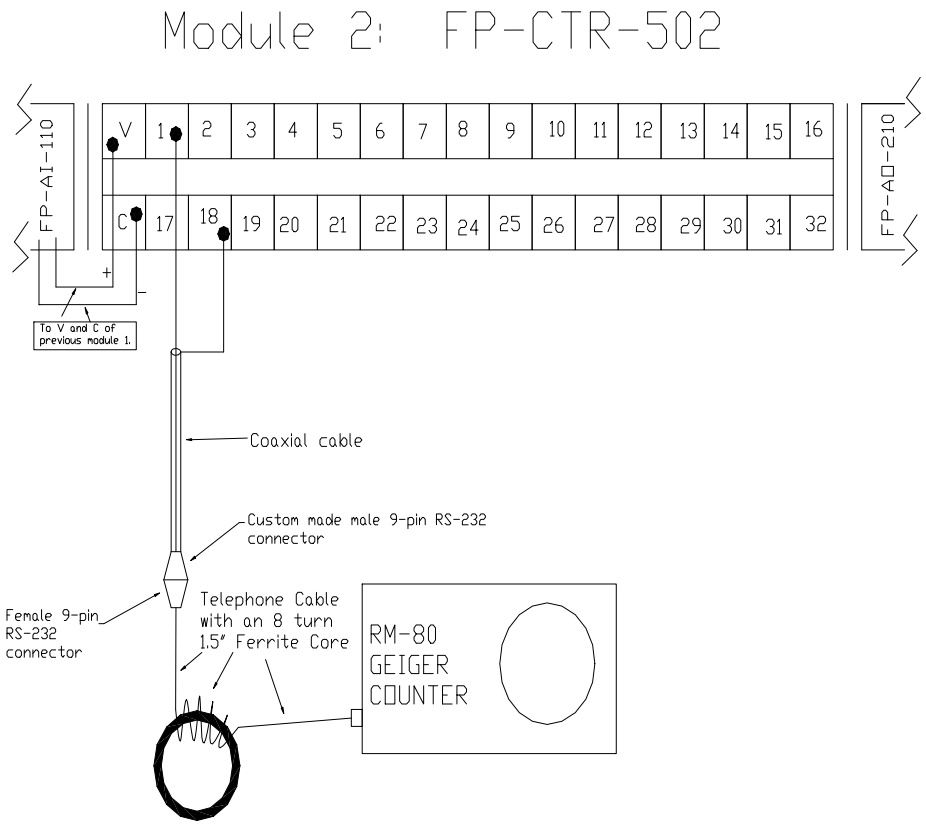


Figure 8. Wiring diagram of Fieldpoint module 2.

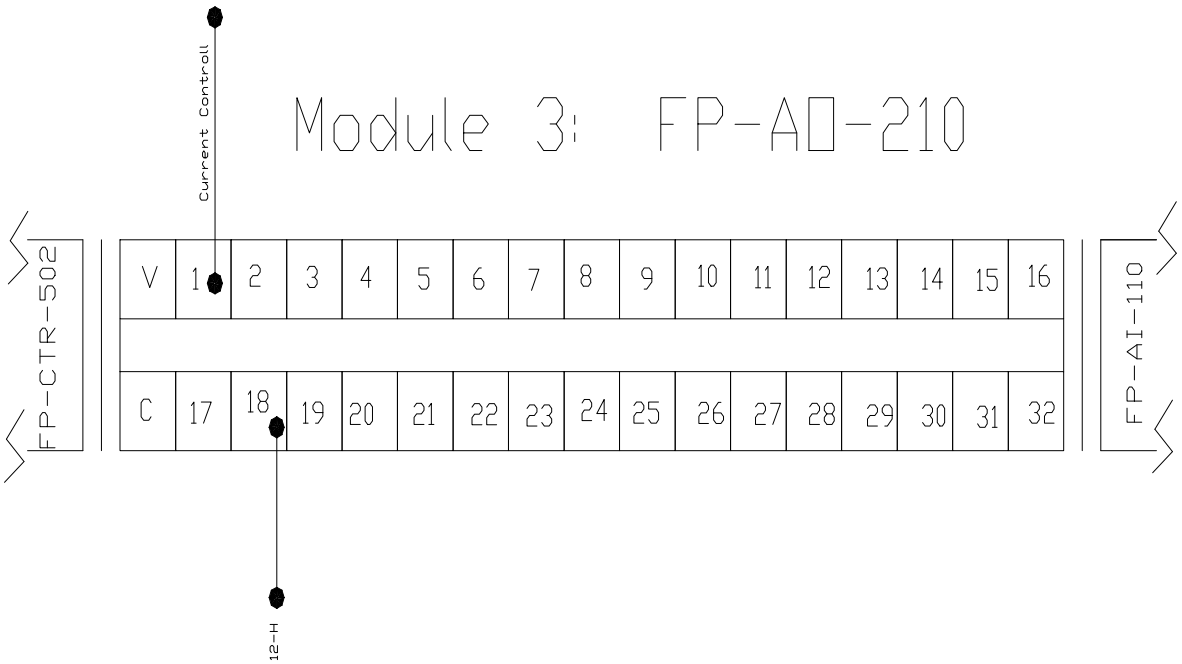


Figure 9. Wiring diagram of Fieldpoint module 3.

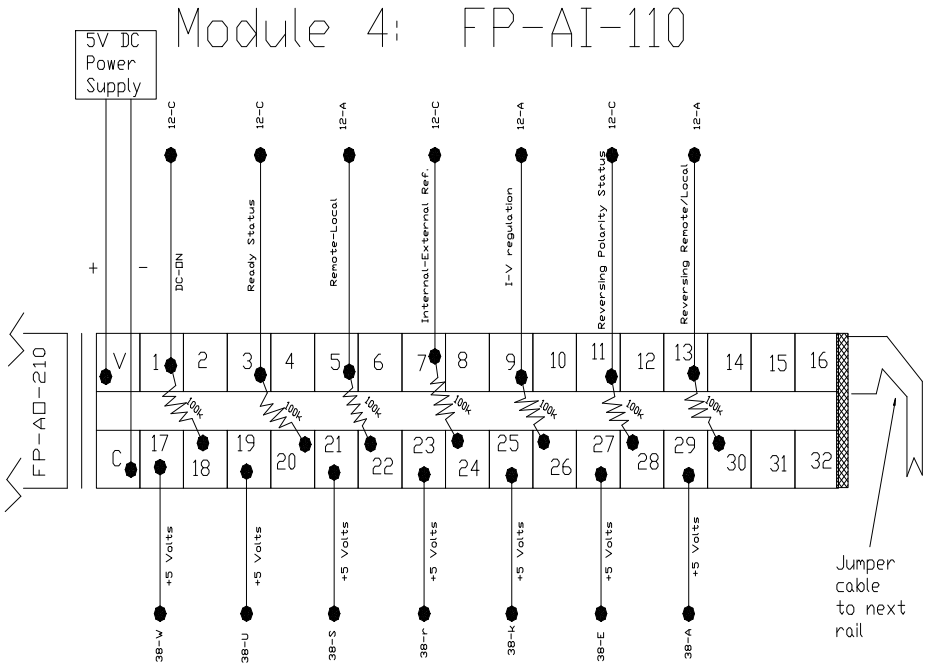


Figure 10. Wiring diagram of Fieldpoint module 4. A 10K resistor is bettween the Vin and COM Fieldpoint terminals (as shown in figure 5) ensuring that Vin is either at ground or at +5V depending on the status of the switch being monitored.

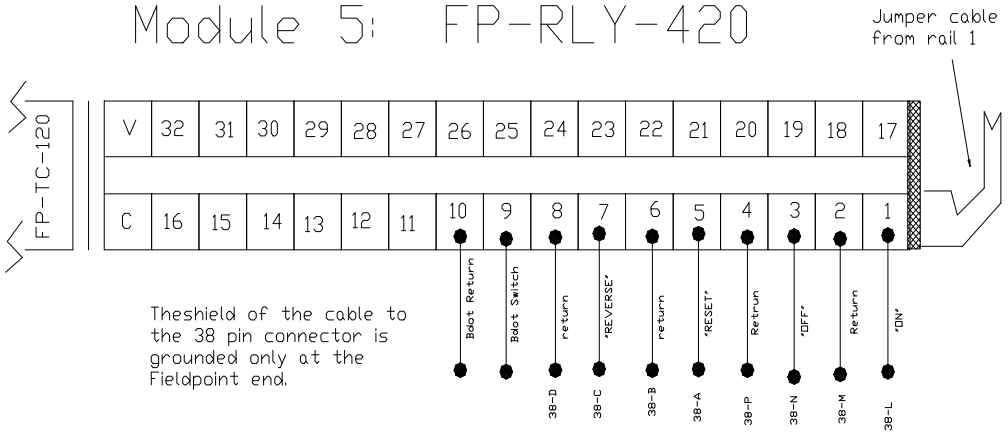


Figure 11. Wiring diagram of Fieldpoint module 5.

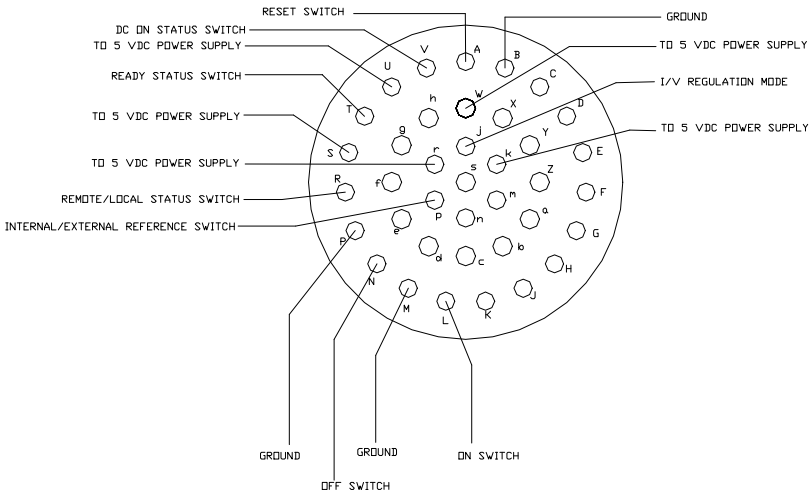


Figure 12. Pin assignments of the 38 pin connector on the magnet power supply patch panel.

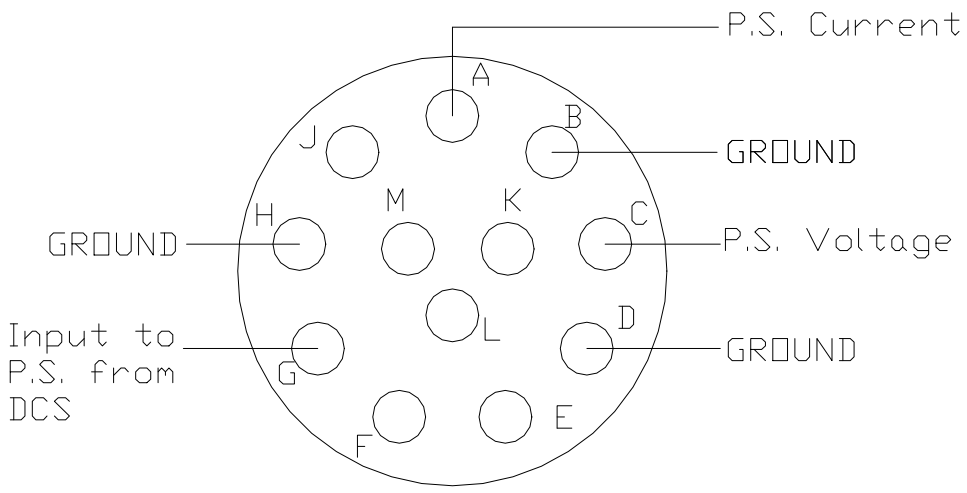


Figure 13. Pin assignments of the 12-pin connector on the magnet power supply patch panel.

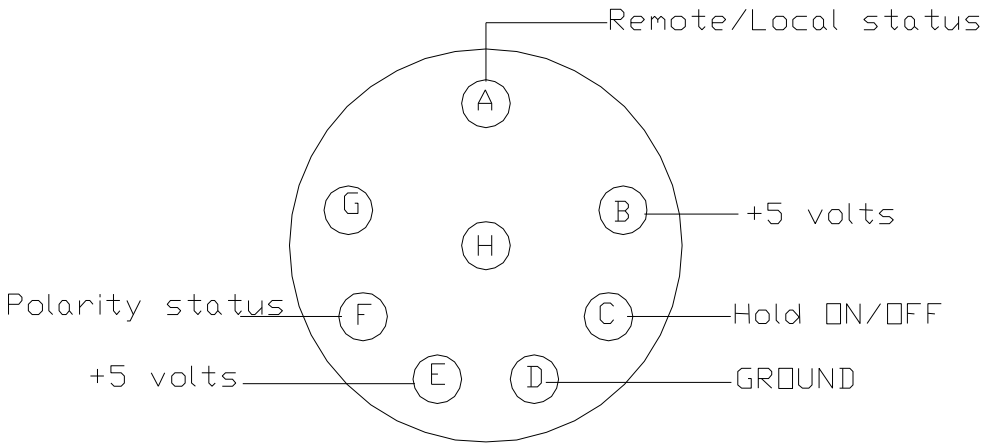


Figure 14. Pin assignments of the 8-pin connector on the magnet power supply patch panel.

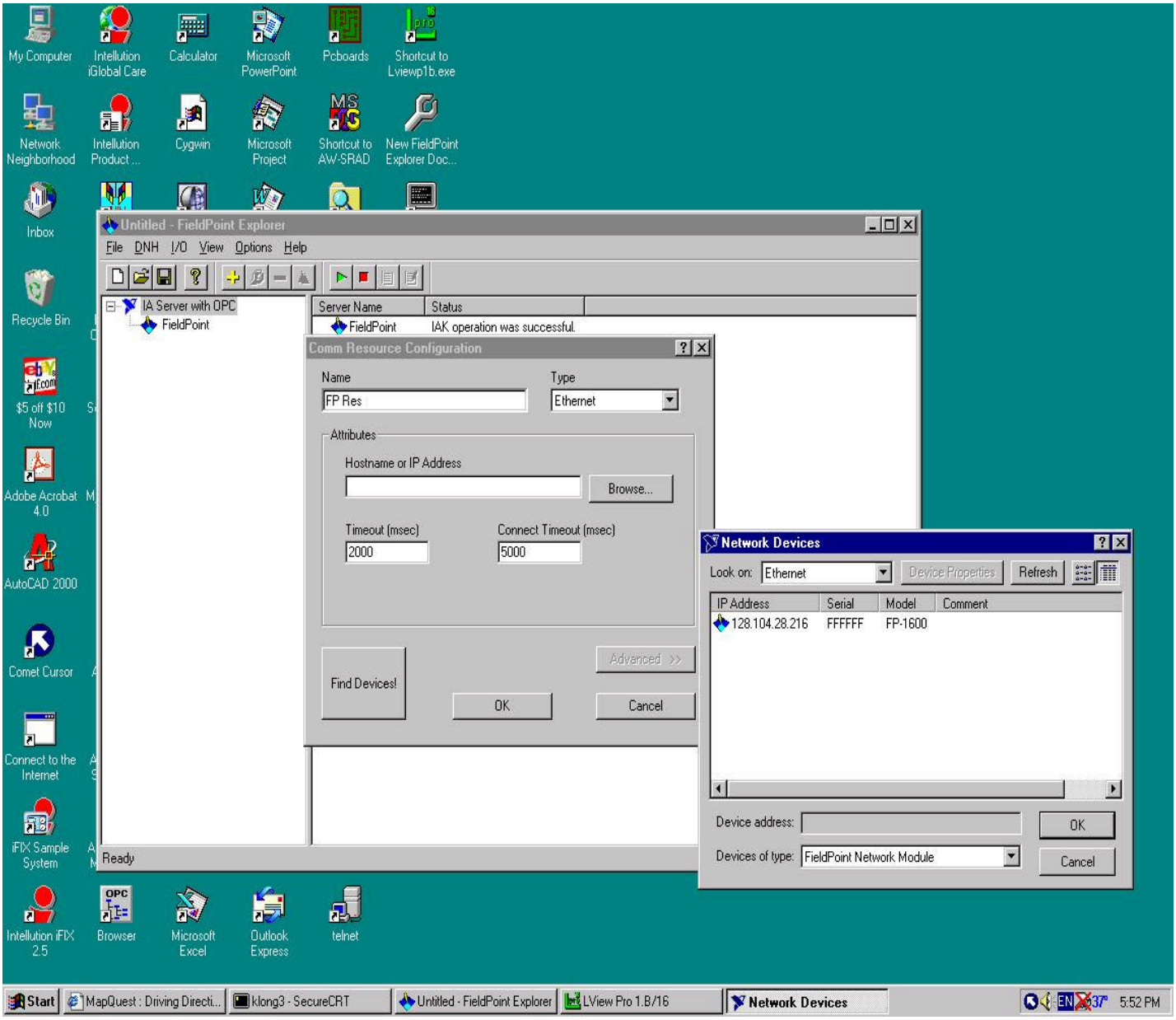
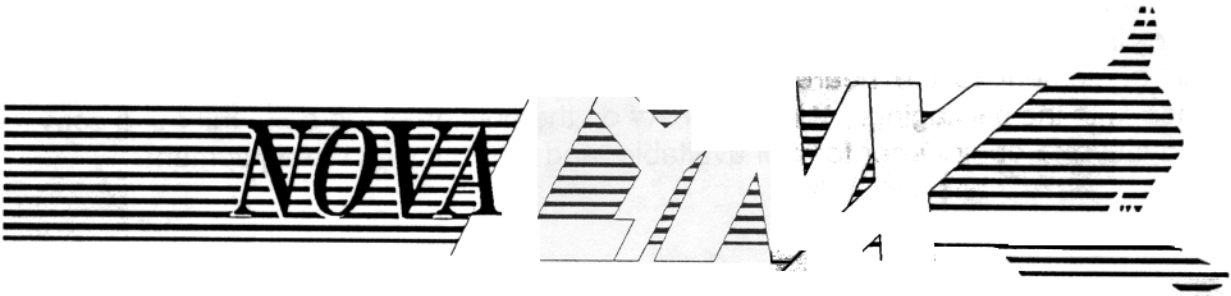


Figure 15. Configuration of the Fieldpoint Explorer. (OPC server for the Fieldpoint setup)

NOVALYNX CORPORATION
MODEL 225-050Y
RELATIVE HUMIDITY AND TEMPERATURE SENSOR

INSTRUCTION MANUAL



Receiving and Unpacking

Carefully unpack all components and compare to packing list. Notify NovaLynx Corporation immediately concerning any discrepancy. Inspect equipment to detect any damage that may have occurred during shipment. In the event of damage, any claim for loss must be filed immediately with the carrier by the consignee. Damages to equipment sent via Parcel Post or UPS require the consignee to contact NovaLynx Corporation for instructions.

Returns

If equipment is to be returned to the factory for any reason, call NovaLynx between 8:00 A.M. and 4:00 P.M. Pacific Time and request a Return Authorization Number (RA#). Include with the returned equipment a description of the problem, and the name, address, and daytime phone number of the sender. Carefully pack the equipment to prevent damage or additional damage in the return shipment. Call NovaLynx for packing instructions in the case of delicate or sensitive items. If packing facilities are not available take the equipment to the nearest Parcel Post, UPS, or freight service and obtain assistance with the packaging. Write the RA# on the outside of the box. Fill out a copy of the NovaLynx Repair Order form, if available, and return it with the equipment.

Warranty

NovaLynx Corporation warrants that its products are free from defects in material and workmanship under normal use and service for a period of one year from the date of shipment from the factory. NovaLynx Corporation's obligations under this warranty are limited to, at NovaLynx's option: (i) replacing; or (ii) repairing; any product determined to be defective. In no case shall NovaLynx Corporation's liability exceed product's original purchase price. This warranty does not apply to any equipment that has been repaired or altered, except by NovaLynx Corporation, or that has been subjected to misuse, negligence, or accident. It is expressly agreed that this warranty will be in lieu of all warranties of fitness and in lieu of the warranty of merchantability.

Address

NovaLynx Corporation
4055 Grass Valley Highway, Suite 102
Auburn, CA 95602
(530) 823-7185
FAX (530) 823-8997

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MODEL 225-050Y
RELATIVE HUMIDITY AND TEMPERATURE SENSOR

1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION

The Model 225-050Y Relative Humidity and Temperature Sensor is a solid state, fully electronic, instrument that provides measurement of relative humidity and temperature. The solid state sensing elements and built-in signal conditioning circuitry produces linear output signals that are compatible with a variety of electronic monitoring and recording instruments. The combination sensor is designed for use in industrial environments and may be installed into tower mounted shields for outdoor applications.

Relative humidity is measured through the use of a thin film capacitive sensing element. The sensor causes changes to occur in the electronic circuitry that are translated into a linear 0 to 1 volt DC output equivalent to 0 to 100 % R.H.

Temperature is measured by a 1000 ohm platinum resistive element (RTD). The miniature platinum element is attached onto the end of the sensor, adjacent to the RH sensor. The changes in the sensor's resistance is translated into a 0 to 1 volt DC output that is equivalent to a range of -40 to +60°C.

The electronic circuitry of the Model 225-050Y is protected inside an IP 65 class housing. The end of the sensor assembly holds the two sensing elements. The humidity element is plugged onto mounting pins through the use of a plastic holder. The mounting pins are also the electrical contacts. The temperature sensor is soldered onto two pins adjacent to the humidity pins.

A protective membrane inside a plastic shield encloses the sensing elements in the end of the probe. The membrane allows moisture to pass through its walls to reach the humidity element while at the same time restricts particulate material from contaminating the sensor. The membrane and shield are non-metallic to prevent delays in the temperature measurement.

Power for the sensor assembly is provided externally by a DC source with a range of 7 to 28 volts DC. For most NovaLynx system configurations, the power will be +12 volts, DC. A one foot length of cable is provided with the sensor whenever no additional cable is ordered from NovaLynx. For some systems, the one foot long cable may be replaced by or spliced onto a longer length of cable, depending upon the system's requirements.

For outdoor and tower mounted sensors, NovaLynx recommends using a solar radiation shield to housing and protect the sensor. NovaLynx instrument shields are used to provide correct exposure of the sensor to the atmosphere while at the same time preventing direct solar heating and precipitation contact of the sensing elements. Several styles of shields are available from NovaLynx. Most of the shields use a clamping style u-bolt to attach the shield onto a tower leg or a vertical mast of 1.0 inches, outside diameter. For best results, a fan aspirated shield should be used. A separate manual is provided for the solar radiation shield when ordered from NovaLynx.

2.0 SPECIFICATIONS

2.1 PHYSICAL PROPERTIES

Size:	
Body Length	2.7" (69mm)
Head Diameter	0.46" (11.8mm)
Lower Body	0.47" (12 mm)
Cable Length:	12" (313mm)
Weight:	6oz (180g)
Case Type:	IP 65
Case Material:	ABS Plastic
Sensor Protection:	Membrane filter, 0.2 µm

2.2 POWER REQUIREMENTS

Supply Voltage:	7 to 28 VDC (+12 VDC Typical)
Current Consumption:	2 milliamps

2.3 OPERATING PARAMETERS

Temperature Range:	
Operating:	+14 to +140°F (-10 to +60°C)
Storage:	-40 to +140°F (-40 to +60°C)
External Output Load:	Greater than 100,000 ohms

2.4 RELATIVE HUMIDITY

RH Sensor Type:	INTERCAP®
Range:	10 to 90 % R.H. at Specified Accuracy
Output Signal Range:	0.0 to 1.000 VDC
Accuracy at +20°C:	±3% RH
Operating Range:	0 to 100% R.H.
Temperature Coefficient:	<±1.5 %RH from -10 to +60°C
Stability:	±2% R.H. over 2 years
Output Signal:	0-1 VDC = 0-100% R.H. (10 mV = 1% R.H.)

2.5 TEMPERATURE

Temp. Sensor Type:	PT 1000, IEC 751, Class B
Range:	+14 to +140°F (-10 to +60°C)
Accuracy:	±0.5°C @ -40°C
	±0.4°C @ -20°C
	±0.6°C @ +60°C
Output Signal:	0-1 VDC = -40 to +60°C
	(10 mV = 1°C)

INSTALLATION

3.1 UNPACKING

Carefully unpack all of the components of the instrument and inspect them for any damage that may have occurred during shipment. In the event of damage, refer to page i of this manual for instruction.

For equipment shipped as a complete set with the sensor installed into the solar radiation shield, inspect the wiring to ensure none of the wires have been pulled from any of the terminal blocks or cable connectors. Remove any packing materials that may have become lodged in the sensor's plastic shield.

SENSOR

The sensor assembly is calibrated at the factory and is ready for immediate use. Power can be applied to the sensor and measurements can be made immediately.

Make any necessary wiring connections to monitoring or recording instruments before applying the power.

If it has been sent as a separate item, remove the sensor from its shipping carton and install the sensor into the solar radiation shield. The sensing element is located at the end of the probe with the smaller diameter and it is covered by a protective membrane. Place the sensing end of the probe into the shield first and slide it into the shield as far as possible but one inch away from the top edge. Wire ties may be used to secure the sensor and its cable to the shield housing.

WIRING

The electrical connections of the Model 225-050Y sensor are presented below. The standard wire colors presented refer to the 12" wire supplied with the sensor whenever the sensor is ordered by itself. The NovaLynx Output Wire Colors refer to extension cable added prior to shipment by NovaLynx. Refer to the system wiring diagram for details regarding exact connections.

STANDARD SENSOR SIGNAL WIRE COLORS

WIRE FUNCTION	SIGNAL VALUE	WIRE COLOR
+ POWER:	7-28 VDC	YELLOW
RH SIGNAL:	0-1 VDC	BROWN
- POWER:	0 VDC	GREEN
NOT USED:		WHITE
TEMPERATURE	0-1 VDC	VIOLET
SHIELD:	0 VDC	BARE

NOVALYNX OUTPUT SIGNAL WIRE COLORS

WIRE FUNCTION	SIGNAL VALUE	WIRE COLOR
+POWER INPUT:	+12 VDC	RED
-POWER:	0 VDC	BLACK
RH SIGNAL:	0-1 VDC	BROWN
TEMP SIGNAL:	0-1 VDC	WHITE

4.0 OPERATION

4.1 RELATIVE HUMIDITY SENSOR

The Model 225-050Y Relative Humidity sensor uses a solid state, thin film, multiple layered device that senses relative humidity. The sensing element acts as a capacitor that changes with respect to the vapor pressure of the air. The sensor's capacitance electrically changes the frequency of an electronic circuit. The sensor signal conditioning circuitry converts the frequency change into an analog voltage. The output signal is a linear DC voltage with a range of 0 to 1 volt DC corresponding to 0 to 100 % R.H. The output signal may be directly used with some monitoring equipment while for other systems, the 0-1 volt signal may require amplification. The excitation to the RH sensor circuitry is +12 VDC. For use with data logging equipment, the sensor may be connected into a power control circuit where the +12 VDC power is switched on and off to conserve the battery. Rapid switching of the power may cause errors in the signal and will require adding a "warm-up" delay to allow the electronics to stabilize. Typically, 5 to 10 seconds of "warm-up" is adequate.

TEMPERATURE SENSOR

Model 225-050Y sensor employs a platinum resistive element or RTD to measure the air temperature. A the air temperature changes, the resistance of the RTD changes as well. An electronic bridge circuit can measure the change in the RTD resistance and can convert the change into a DC voltage. The output signal is scaled to 0-1 VDC that is equal to -40 to +60°C. Since the RTD is wired into the humidity sensor electronic circuitry, ant warm-up time for the RH sensor will also be applied to the RTD.

CALIBRATION

5.1 SENSOR CALIBRATION

The Model 225-050Y combination Humidity/Temperature Sensor does not require calibration and has no calibration adjustments available to the user.

The calibration can be checked and compared to standard sensors to ensure that the sensor is working properly and that the sensing elements have not changed. To maintain accurate readings the sensor calibration should be checked at least annually. For sensors located in areas where there is severe dust and atmospheric pollutants, it is recommended that the sensor be checked more often. For best results, a quarterly system audit is recommended.

5.2 FIELD CHECKING RH

If the sensor to be checked is located in a remote area, NovaLynx recommends taking along a second RH sensor element to replace the original sensor element in case it is out of the specified accuracy range. Due to the stability of the sensor design it is not necessary to perform an actual calibration adjustment to the sensor electronics. Replacement of the sensing element is recommended every two years for the best results.

If a second RH sensor is unavailable, the next easiest way to check the probe operation in the field is to compare the relative humidity sensor output against an accurate psychrometer. If the humidity readings are within +/- 4 % R.H. then the sensor is good and does not need to be replaced. If the reading error is greater, then the decision must be made whether to replace the sensor or to use it for a longer period of time. Remember to include the accuracy of the test instrument (psychrometer) in the decision process. Most often the accuracy of the test instrument or psychrometer will be less than the accuracy of the electronic sensor.

For best test results, the Assmann style psychrometer, Model 225-5230 is recommended. The Assmann psychrometer uses a spring driven fan and has precision thermometers. An easier method is to check the sensor operation using a second electronic sensor such as Model 225-HM34-C. The 225-HM34-C uses the same sensing elements and allows

quick and easy checking of the humidity and temperature. Reading of the 225-HM34-C is direct using the built-in LCD display.

Should the RH probe appear to be out of calibration even after changing the sensing element, contact NovaLynx for instructions. For best results, the RH sensor should be tested in an accurate RH calibration chamber (Model 220-HMK11) under controlled conditions.

Any signal conditioning provided for use with the sensor has been adjusted at the factory by simulating the sensor with a precision DC voltage source. Verify that the signal conditioning or monitoring equipment is operating correctly and make any necessary adjustments before testing the sensor. Retest the sensor with the signal conditioning or monitoring equipment after making any adjustments to determine whether or not the sensor is correctly calibrated.

NovaLynx provides the Model 220-HMK11 for testing and calibrating electronic RH sensors by the user. The calibration chamber uses saturated salt solutions to check the %RH at 96% and at 12%. The calibration chamber works best in stable temperature conditions such as those found indoors or in laboratories. The chamber can be used to make quick and accurate field tests of an electronic humidity sensor calibration since the chamber is always at the indicated humidities. Sensor readings can be taken within a few seconds. The chamber humidity reading is corrected according to the temperature readings of the built-in thermometer. The chamber is a good test device to check to overall operating range of the humidity sensor. Spot checking at ambient conditions may not always detect a marginally defective sensing element.

5.3 FIELD CHECKING TEMPERATURE

Field testing of the temperature sensor can be performed using methods similar to those used to test the humidity. As with the RH sensor, there are no user adjustments available for the temperature sensing portion of the 225-050Y.

If a psychrometer, such as the Assmann type, is used to check the humidity sensor, the dry temperature thermometer can be used to verify the temperature readings of the 225-050Y. The same is true of the electronic psychrometer, Model 225-HM34-C since it incorporates a direct reading thermometer.

If it becomes necessary to perform an ice bath test of the 225-050Y temperature sensor, it is important to note that the sensor must be covered by a water proof barrier in order to protect the RH sensing element. Placing the end of the sensor into water with power applied will damage the RH sensor.

For both RH and temperature testing, it is important to remember to place the test instrument sensing element into close proximity with the end of the 225-050Y sensor. If this task is difficult to accomplish due to site configuration, remove the 225-050Y from its shield, and place it into an insulated box or bag alongside the test instrument.

Return the sensor and mounting hardware to its original configuration upon completion of the testing. Check to see that the equipment is operating correctly prior to leaving the site.

MAINTENANCE

The Model 225-050Y sensor assembly requires little or no maintenance. The only recommended maintenance is a general cleaning of the outer case and routine testing of the sensor's operation.

Regular inspections of the sensor should be made to detect problems with the cable and to prevent build-up of dirt, dust and atmospheric pollutants.

Routine care and maintenance of the exteriors of the instruments, housings, and shields will increase the life of the equipment. Inspections of the fasteners and mounting hardware should also be performed regularly. Look for loose or missing nuts and bolts that may vibrate loose during high winds due to movement of the tower or mast.

For critical situations, NovaLynx recommends keeping spare sensors or sensor components on hand for immediate replacement of the primary equipment should severe damage occur. Spares kept using method will help decrease down time during emergencies.

CLEANING THE RH SENSOR

The humidity sensor element is a thin film polymer plastic that is very sensitive to oils from human skin. **Do not touch the sensor element with your fingers**. There is no method for cleaning the element, however it may be rinsed using clean de-ionized water should the sensor become extremely dusty or dirty. Power should always be removed from the sensor before rinsing the element. The plastic protective guard with the protective membrane located on the end of the sensor must be removed to expose the sensing elements. The plastic guard is threaded and must be carefully unscrewed for removal. The element may be left attached to the end of the sensor or it may be removed. To remove the element grasp the plastic protective housing along the edges and slide the element upward, away from the body of the probe. Allow the element to thoroughly dry before reapplying power to the probe. Replace the membrane filter cap if it appears to be dirty. Do not attempt to clean the filter.

WARNING: Never attempt to clean the sensor assembly by mechanical means such as brushing or wiping. The sensing element will become permanently destroyed by attempting such a procedure.

If the humidity element is suspected of being defective, replace it immediately with a new element. The humidity element will deteriorate over a period of two years and should be replaced after it has been in service for that length of time. Replacement of the element usually does not affect the probe electronics. However, the probe operation should always be checked after replacing the sensing element.

CAUTIONS

1. Do not insert any object into the sensor housing that could physically damage the sensing elements.

2. Do not expose the sensor probe to temperatures lower than -40 degrees C or higher than 125 degrees C.

3. Do not expose the sensor probe to strong acids or bases.

4. Do not operate the probe with the sensing elements in contact with water.

5. Do not expose the probe to high levels of sulphur dioxide.

6. Do not let the RH sensing element come into contact with human skin.

7. Do not operate the humidity probe for long periods with the protective membrane removed.

8. Do not attempt to clean the RH sensing element.

TROUBLESHOOTING

The Model 225-050Y Relative Humidity and Temperature Sensor is a simple instrument to use and, except for possible contamination of the humidity sensing element, it should be virtually trouble-free.

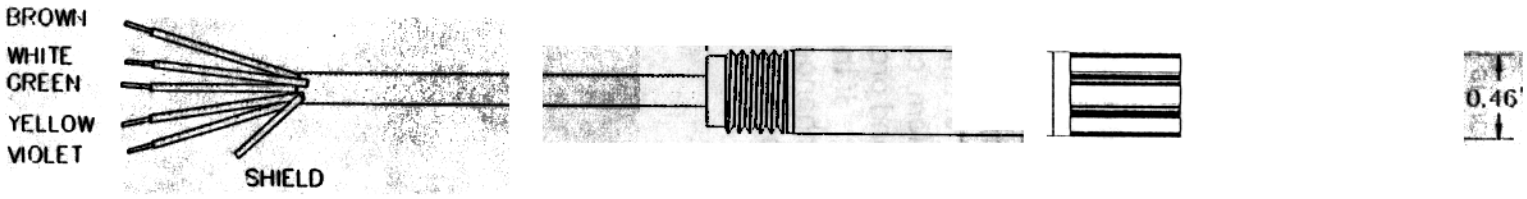
Always disconnect the input power and begin to troubleshoot immediately whenever any of the following conditions occur: the instrument does not produce an output signal; the output signal appears to be missing; the output signal exhibits a marked change in performance; the instrument has been dropped or damaged; lightning has struck near the sensor; moisture has invaded the vapor membrane and plastic shield.

7.1 POWER PROBLEMS

If the sensor's output signal appears to be in error or is absent, check the power connections. At the sensor cable, measure the battery or the input power source voltage with a voltmeter. Be sure that the instrument has been powered up correctly or wait for the next power ON cycle to occur. Check any batteries to be sure that they have sufficient charge and an adequate voltage level to power the instrument and that all connections are secure. Inspect the battery terminals to ensure that they are clean and solidly connected to the battery.

7.2 DETERMINING THE SOURCE OF A FAILURE

To determine whether the trouble is in the sensor or the electronics, try to manually operate the sensor, by increasing the relative humidity or temperature near the sensor. Changing the humidity can isolate a defective RH sensing element quickly. Breathing heavily onto the humidity sensor should produce an immediate increase in the humidity output signal. Holding the end of the sensor tightly for a brief time should give an elevated temperature reading. If it is impossible to locate the problem, contact NovaLynx to return the unit to the factory. If the translator electronics respond properly to simulated sensor inputs then the trouble may be somewhere in the sensor. If there is no humidity sensor signal or if the humidity signal does not change with a change in humidity, the sensing element may be defective. The same is true of the temperature sensor. If spare sensing elements are not available, contact NovaLynx.



12" WIRE
STANDARD CONFIGURATION

STANDARD SENSOR WIRE FUNCTIONS

COLOR	FUNCTION	VALUE
YELLOW	+POWER	+12 VDC
BROWN	RH SIGNAL	0-1 VDC
GREEN	-POWER	0 VDC
WHITE	NOT USED	N/A
VIOLET	TEMP SIGNAL	0-1 VDC
BARE	SHIELD	0 VDC

NOVALYNX OUTPUT SIGNAL WIRE COLORS

WIRE FUNCTION	SIGNAL VALUE	WIRE COLOR
+POWER INPUT:	+12 VDC	RED
-POWER:	0 VDC	BLACK
RH SIGNAL:	0-1 VDC	BROWN
TEMP SIGNAL:	0-1 VDC	WHITE

NOTE: UNUSED WIRES MAY BE CUT OFF.
REMOVE YELLOW PLASTIC MOISTURE GUARD BEFORE USING SENSOR.

NOVALYNX CORPORATION

TITLE
OUTLINE, HUMIDITY & TEMPERATURE SENSOR

MODEL USAGE | SHEET

BY RGN | SCALE | DWG NO

User's Guide

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It is the policy of OMEGA to comply with all worldwide safety and EMC/EMI regulations that apply. OMEGA is constantly pursuing certification of its products to the European New Approach Directives. OMEGA will add the CE mark to every appropriate device upon certification.

The information contained in this document is believed to be correct, but OMEGA Engineering, Inc. accepts no liability for any errors it contains, and reserves the right to alter specifications without notice.
WARNING: These products are not designed for use in, and should not be used for, patient-connected applications.

General Information

Your pressure transducer has been carefully calibrated before shipment to you and it should be handled with the same care given any precision instrument. Accuracy and dimensions are reported on the specification bulletin for the transducer. The label on the unit specifies the calibrated output voltages at the low end and the high end of its pressure range.

Environmental Conditions

Do not use in ambient conditions corrosive to the stainless steel housing or PVC jacketed cable, submerge in liquids or subject to spray or vibration environment.

Temperature - The PX2760 is designed to operate and be stored with the following temperature limitations:

Operating:	0 to 175°F (-20 to 80°C)
Storage:	-65 to 250°F (-55 to 120°C)

Media Compatibility - The media exposed to the wetted portions of the PX2760 must be Non-condensing air or gas compatible with stainless steel, alumina ceramics, gold and elastomers (silicone).

Induced Environments - The PX2760 can withstand the following environments for vibration, shock and acceleration. Keep in mind that the unit accuracy is affected by each of these conditions and means should be made to avoid these induced environments to the best extent possible:

Vibration:	2g from 5 to 500 Hz
Shock:	50g operating, 1/2 sine 10 ms
Acceleration:	10g maximum

Electrical Connections

The PX2760 is provided with a standard 2 foot multiconductor “Belden” cable. The electrical connections by color code are listed below:

Function	“Belden” Cable Lead (#8723 Grey Cable)
Positive Excitation	Red
Positive Output	Green
Negative Output	White
Negative Excitation	Black
Case	Shield

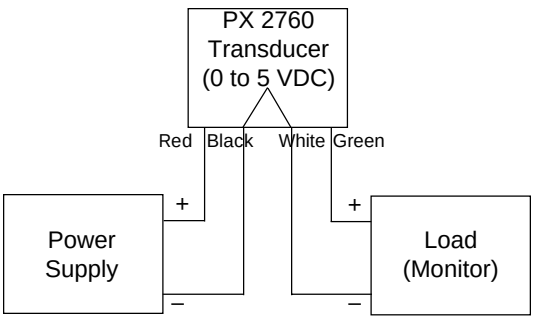

Figure 1

Input Power

The electrical circuit is a 3-terminal circuit. Separate leads for negative output (White) and negative excitation (Black) are provided for convenience in wiring but are internally commoned (see Figure 1). Use of these leads also avoids errors in voltage reading caused by ground loops, which can occur in 3-wire devices.
The pressure transducer should be operated with the shield connected either to the negative excitation wire or to the negative output wire. Failure to do this may result in unsatisfactory operation of the unit.

The PX2760 is designed to operate at 12 VDC input voltages. The 12 VDC unit has a 0.1 to 5.1 VDC output. The input voltage limit is 9.0 to 14.5 VDC.

Note: The circuit is not protected against mis-wiring. Use extreme care in wiring the positive excitation voltage to the red wire, and ensure all four leads are correctly connected before applying power. Reversed or mis-wired excitation may cause permanent damage to the transducer.

In some instances, use of long cable (several hundred feet long) may introduce enough cable capacitance into the output circuit to cause oscillation. If encountered, this oscillation may be eliminated by connecting a 100 ohm resistor (1/8 watt or larger) in series to each of the output leads at the end of the 2 foot transducer cable. These series resistors add to the output resistance.

Mounting and Pressure Fitting

The PX2760 is provided with an integral bracket for mounting. The bracket contains two (2) #11 holes for mounting the unit to the intended surface.

The PX2760 is provided with a 1/8” O.D. plastic push on tube fitting.

Calibration

This unit has been precision calibrated at the factory. It has been designed to be inherently stable; recalibration adjustments are not normally field accessible. If you do wish to perform a recalibration, and have access to a high accuracy primary pressure standard, call the factory for instructions on field access to the calibration adjustments.

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA Warranty adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's's control. Components which wear are not warranted, including but not limited to contact points, fuses , and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by it will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSO EVER, EXPRESS OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED.

LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/ DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRES

Direct all warranty and repair requests/inquires to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence. The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS,
please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes. This affords our customers the latest in technology and engineering.

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M-3246/0399

AWARE
Electronics

RM-80 RADIATION MONITOR
With 7313 Tube
--SUPPLEMENT--

Aware Electronics Corp.
P.O Box 4299
Wilmington DE 19807

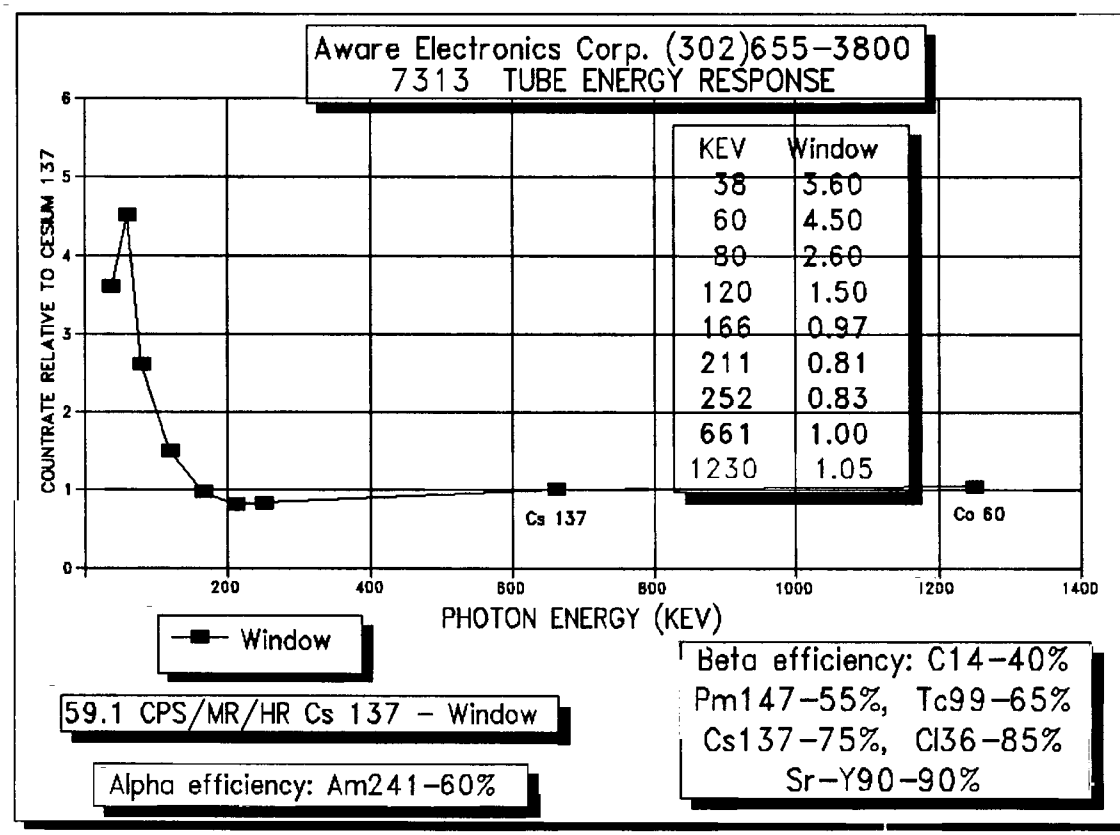
(302) 655-3800

RM-80 with 7313 TUBE
-SUPPLEMENT-

The RM-80 radiation monitor is intended for use in conjunction with a P.C. compatible computer or a LCD-60. The monitor is based on the RM-60 microR monitor, but uses professional grade type 7313 pancake detector. For general operating instructions, refer to the RM-60 operating manual.

When operating the software with an RM-80, change the "Factor Rad. Calibration" setting (found as a sub-menu selection under the "Setup" menu) to 354 for the 60 sec. TBU mode and 59 for the 10 sec. TBU mode. This will cause the software to display the generated data calibrated to Cs 137, in microR/hr., with the beam directed toward the window, which is the same as 1/100th of a micro sievert CμS (Centi Micro Sievert). Changing the "Factor Rad. Calibration" has no effect on the raw radiation files, but only on how the raw data is interpreted and displayed. (See RM-60 manual). When calibrated in this manner, background readings will be a little lower than those from the standard RM-60 with 712 tube due to the reduced side response of the 7313 tube. (Compare the polar response graph of the 7313 tube, found in this supplement to the polar response graph of the 712 tube found at the end of RM-60 manual). Note: To display in counts per TBU, set both "Factor Rad. Calibrations" to 100.

About the "Tube Energy Response" graph, the X-ray machine used for generating this graph was capable of generating X-rays with energies as low as 38 KEV, hence the lower end of the X-axis stops at 38 KEV. On the other hand, the "Tube Energy Response" graph on page 17 of the RM-60 manual was created with an X-ray machine capable of energies down to 10 KEV, hence the X-axis extends down to 10 KEV. Since the thickness of the RM-80 window is the same as the thickness of the RM-60 window, the shape of the response curve below 38 KEV should be similar.



Tube Data

7313 (RM-80)
Min. Dead Time: 30 μS
Window
Areal Density: 1.5 to 2.0 mg/cm^2
Eff. Diameter: 1.75" (44.45mm)
Area: 2.41 Sq. In.
Material: Mica

Wall
Thickness: 0.187"
Eff. Length: 0.5" (12.7mm)
Eff. Diameter: 1.75" (44.45mm)
Material: 466 SS

712 (RM-60)
Min. Dead Time: 30 μS
Window
Areal Density: 1.5 to 2.0 mg/cm^2
Eff. Diameter: 0.360"
Area: 0.102 Sq. In.
Material: Mica

Wall
Thickness: 0.012"
Eff. Length: 1.5"
Eff. Diameter: 0.566"
Material: 446 SS

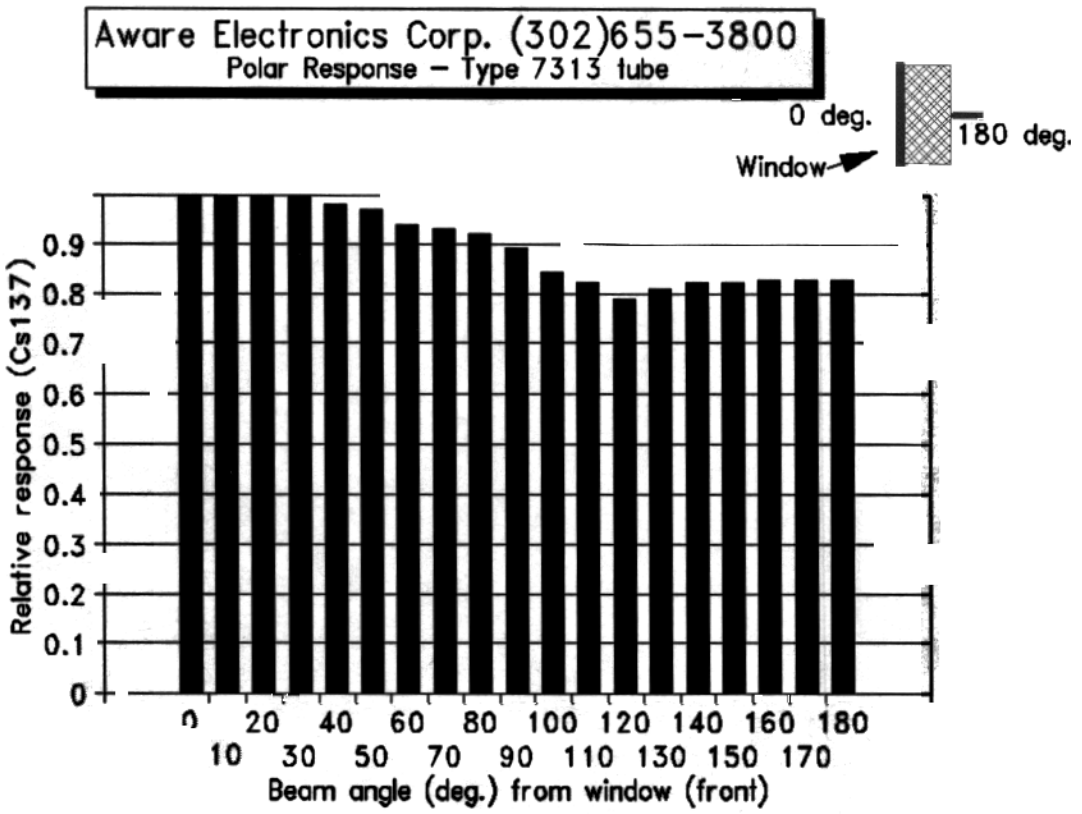
The RM-60\RM-80 and software are digitally locked to the tube. No analog adjustments are necessary. Cesium 137 calibration: +/- 5%. Each tube has passed all examinations, inspections, tests and calibrations of the LND Quality Assurance Procedures including DCAS MIL-Q985A, MIL-E-I and appendix B of 10CFR50. Calibration is accomplished in accordance with MIL-STD-45662. Sources for calibration and/or dose rates have calibration traceable to National Bureau of Standards.

Both tubes are halogen quenched. The RM-80 includes a screw-on stainless steel wire mesh cover to help protect the mica window from damage. The open area of the mesh is 72%. You can carefully unscrew the cover, if so desired, but do not allow anything to touch the mica window. To clean dust off window, use a gentle stream of air supplied for example from "Dust Remover Spray" (Radio Shack) normally used to blow dust from cameras, keyboards, etc.

The RM-60/80 case is ABS. You could cement ABS or PVC mounting brackets, etc. unto the case, using "Universal ABS-PVC" cement.

A slight jingling sound from within the RM-80 tube is normal. It is a dissipation wire.

7313: Nominal cpm/mR/hr for Cs-137: 3545



Neutron Sensitivity for Pu-Be inclusive of Gamma Emission @ the given neutron flux:

Tube type 7313:
1.5 CPS/N/CM²/SEC (Window)
0.8 CPS/N/CM²/SEC (Side)

Note: The RM-80 makes an excellent thyroid checker. Just hold window up against throat, on tyroid area. Levels of iodine 125, 123 or 131, well below 1 microcurie, are easily detected.

RM-70, RM-80, RM-280, RM-680 and RM-G90

As mentioned in the RM-60 brochure, Aware Electronics has available other types of radiation monitors, including pancake tube monitors. Two such units are the RM-70 and RM-80. They are the same size as the RM-60 (4.4" x 2.44" x 1.06") except the front cover has a 1.5" (RM-70) or 2.4" (RM-80) diameter threaded stem projection, in which is mounted a pancake style geiger tube.

	Type 712 tube: RM-60	Type 7231 tube: RM-70	Type 7313 tube: RM-80
Window:			
Areal Density:	1.5 to 2.0 mg/cm^2	1.5 to 2.0 mg/cm^2	1.5 to 2.0 mg/cm^2
Eff. Diameter:("/mm)	0.360/9.14	1.125/28.57	1.75/44.45
Area:("^{2}/mm^2)	0.102/65.61	0.996/641.08	2.41/1552
Material:	Mica	Mica	Mica
Wall:			
Thickness:("/mm)	0.012/0.381	0.06/1.52	0.187/4.75
Eff. Length:("/mm)	1.5/38.1	0.48/12.19	0.5/12.7
Eff. Diameter:("/mm)	0.566/14.38	1.126/28.6	1.75/44.45
Material:	446 SS	446 SS	466 SS
Nominal cpm/mR/hr for Cs-137:	1050	1490	3545

The RM-60 is excellent for general purpose monitoring of Alpha, Beta, Gamma and X-ray, as described in the RM-60 brochure. Since the RM-70 & RM-80 alpha windows are approximately 10 & 24 times larger than the RM-60's alpha window, the RM-70 and RM-80 provide 10 and 24 times higher sensitivity to Alpha, Beta (for example Radon daughters) and/or lower energy X-ray. The RM-70 is slightly more sensitive to Gamma then the RM-60. The RM-80 is more than three times as sensitive to gamma. (Most geiger counters measure only gamma radiation). RM-70 with AW-SRAD software, cable assembly and adapter: $240.00. RM-80: $319.00 (Excellent thyroid checker for I 123, 125 & 131 below 1 μ curie).

The RM-60/70/80 and software are digitally locked to the tube. Each tube has passed all examinations, inspections, tests and calibrations of Quality Assurance Procedures including DCAS MIL-Q985A, MIL-E-I and appendix B of 10CFR50. Calibration is accomplished in accordance with MIL-STD-45662. Sources for calibration and/or dose rates have calibration traceable to National Bureau of Standards. (Aware Electronics reserves the right to substitute tubes with tubes of the same or higher quality).

RM-70, RM-60, RM-80 & LCD-60

All tubes are halogen quenched. They are constructed of specially coated stainless steel, mica and ceramic. Joints are fused shut in a furnace with molten glass. They are very rugged. The RM-70\80 includes a screw-on stainless steel wire mesh cover to help protect the mica window from damage The open area of the mesh is 72%. You can unscrew the cover, if so desired. The RM-60's stainless steel mesh is built into the case. The RM-60/70/80 case is ABS. You can cement ABS or PVC mounting brackets, etc. onto the case, using "Universal ABS-PVC" cement.

In addition to the RM-60/70/80, Aware Electronics has available the RM-280 with two 1.75" effective diameter pancake tubes ($479), the RM-G90 ($360) with a 10.5" x 0.8" gamma tube (9600 cpm/mR/hr) and the RM-680 with six 1.75" effective diameter pancake tubes mounted in a rugged aluminum housing with handle ($1250). AW-SRAD software, cable assembly, two adapters and manual are included.

The RM-70,80,280 and G90 can be ordered with weatherproofing, which includes hard wired 12 ft. cable and permanent sealing (case sealed shut with ABS to ABS fusion), for an additional $30.00. (Non-weatherproof versions include a modular jack built into the case, into which the cable snaps in place)

Just like the RM-60, all models work with any 100% IBM compatible, including "Palm Tops" such as the H.P. LX100-200, "Notebooks", "Lap Tops", "Desk Tops", etc., or alternatively, with the LCD-60. All units covered by the same 5 year warranty as the RM-60 (tubes covered separately for 6 months) and include the 45 day money back guarantee. (*Also available: Energy compensated X-ray monitors. Flat from 50 kev to 1.5 mev., .1mr/hr. to 50 R/hr., $299; 500V-700V-900V tubeless box with BNC connector, $169.50*) (Intro. prices for a limited time.) Questions: Phone or fax at: (800)729-5397 or (302)655-3800.

-Over-

Vist our web site at:
http://www.aw-el.com
email: aware@aw-el.com

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Aware Electronics Corp.'s primary products are a group of Micro Roentgen Radiation Monitors including the RM-60, RM-70, RM-80 and RM-G90 monitors. These palm sized units are assisting universities, professionals, hobbyists and laymen, worldwide. They provide an interesting, powerful and easy method of detecting and plotting ionizing radiation on a P.C. or LAPTOP computer. Each monitor is extremely rugged and accurate. Thousands have been sold for over seven years. Excellent for educational and industrial purposes as well as for checking minuscule amounts of contamination in foods, water, ceramic materials, etc., or for continuously monitoring background radiation levels, including radiation due to the presence of Radon and decay products.

The monitors plug into the serial or parallel port of the P.C. by way of telephone cord, turning the computer into a highly sensitive, feature packed, user friendly, micro roentgen geiger counter. Data is displayed in a unique scrolling bar chart format, and is saved to a file, for later review and manipulation. Each point is accompanied by the exact date and time according to the quartz clock in the computer.

The RM-60, along with the user friendly software, ($149.50 complete system) monitors & plots radiation from a variety of sources. It includes the highest quality stainless steel geiger tube with alpha-beta window and ceramic back. The RM-60 detects all three types of radiation emitted by radioactive materials, namely alpha, beta, and gamma radiation, as well as X-ray radiation down to 8 KEV.

The RM-70 ($240) and RM-80 ($319) monitors include the highest quality, industry standard, stainless steel "pancake" tubes (1.125" and 1.75" effective diameter alpha, beta, low energy gamma\X-ray windows). The RM-G90 ($360) includes a 10.5" x 0.8" stainless steel gamma tube (160 cps\milliR\hr).

You can use a credit card to order if you desire. If you are displeased for any reason, you may return the unit within 45 days for a full refund. If you decide to order, may we suggest the purchase of the additional program Aw-graph.exe for $74.00. It includes the ability to view several radiation data files simultaneously, including regressions, interpolations, date-time x-axis, data compression, semilog plots, background subtraction, video page switching, GIF graph export, etc. It includes *real-time automatic update of data plot(s)*, as well as old data and/or any ascii data. Aw-graph is covered by the 45 day $ back offer. It is a superb add-on program.

Note: Several utilities are included with each RM system. These include SEED.EXE which generates random numbers derived from RM pulses, SECTION.EXE which pulls any Date-Time data segment from a large data file, SETCLOCK.EXE which uses a modem to connect with Atomic Clock in Boulder Colorado, then adjusts PC's clock, Flux Counter, which tallies radiation counts until spacebar is pushed, Stufkbuf.exe which places keystrokes in the keyboard buffer, etc.

NEW AW-RADW Full Featured Windows 98-ME-NT-2000-XP Program Available. See WWW.AW-EL.COM for details.

RADON:
Even in a room with only outdoor Radon levels, one can gather Radon decay products on a tissue by wiping the screen of a TV and then plot the decay with an Aware monitor and software. (Half life Radium B: 26.8 mins., Radium C: 19.9 mins.) Very interesting. Use one of the Monitors to find Radon entrance points. For example, if Radon is entering through a crack, decay product will deposit around the periphery of the crack. When moving the monitor close to the crack, geiger clicking will increase and the dose rate display will show a rise in radiation, due to the highly radioactive decay products. This reveals the crack as a source of Radon entrance.

We received a phone call from an interesting RM-60 user recently. He has been an alpha track dealer for several years, and is very pleased with the system. He placed a face mask paper filter on the intake of a small vacuum cleaner (e.g. Dust Buster) for two minutes, in a room with approx. 3 pico-curies Radon per liter air. Next he placed the paper filter on the RM-60. This generated readings of several hundred counts per minute. (Background count rate is normally about 12 CPM). The software then drew a beautiful decay plot of the Radium B + C Radon daughters. The RM-70 and RM-80 will draw a decay curve with 10 and 24 times the data.

Others have found small amounts of radioactive contamination in drinking water, due to Radon, by simply placing the monitor next to a tank of water and noticing the increase in reading. Floor drains, pipe entrances, sump pumps, vent openings, etc., all will become radioactive if Radon is entering through and\or around them. The RM system allows you to notice the effectiveness of remedial action. Also, real-time variations due to water flow, weather conditions, etc. are revealed on the graph, and by way of the geiger click and reading.

INTERESTING ARTICLE IN SCIENTIFIC AMERICAN: (Jan. 1996, pg.44, The Real Threat of Nuclear Smuggling) "In late 1993 Russian "Mafia" assassins allegedly planted gamma-ray-emitting pellets in the office of a Moscow businessman, killing him within months. At least half a dozen similar incidents have been reported in Russia since then".

Aware Electronics Corp. / Bryan J. Boardman / Manager

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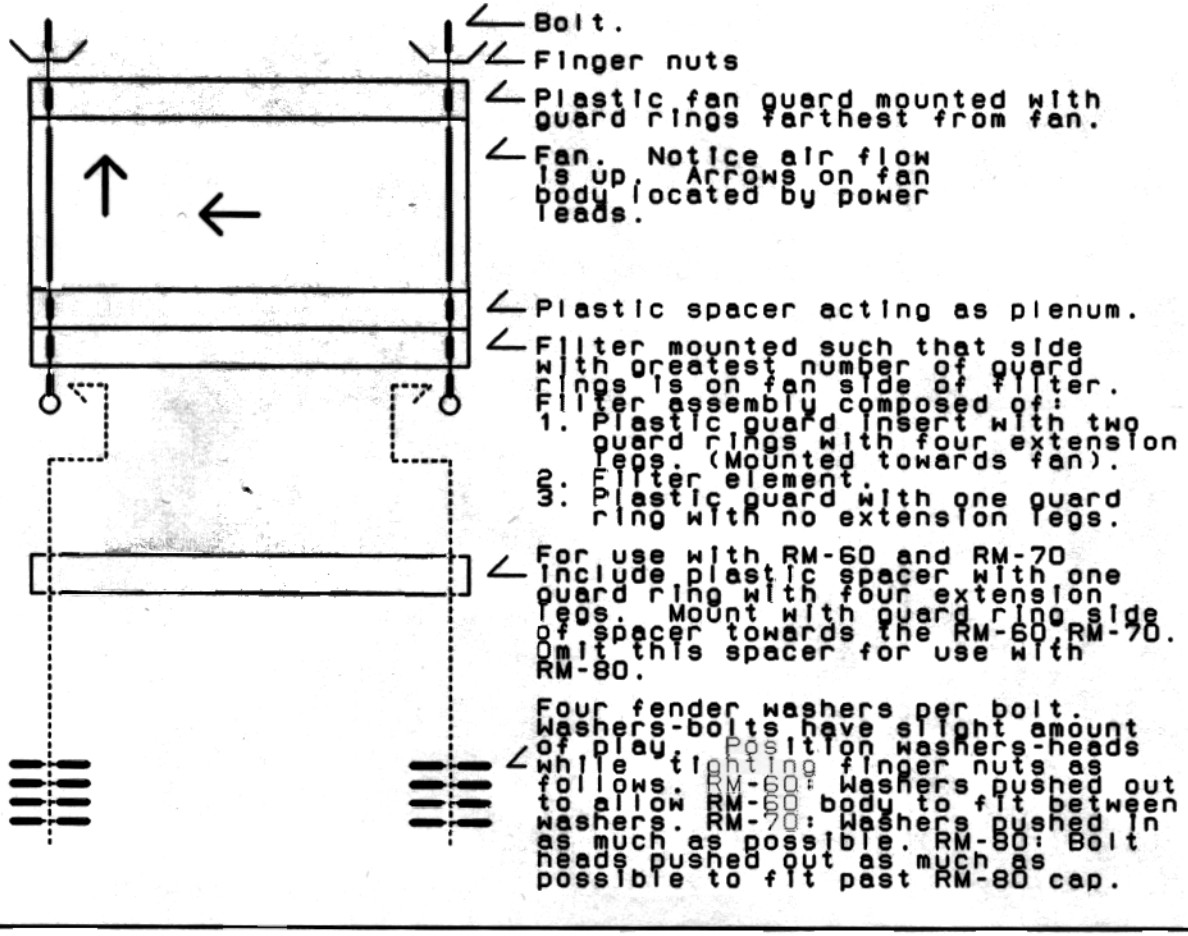
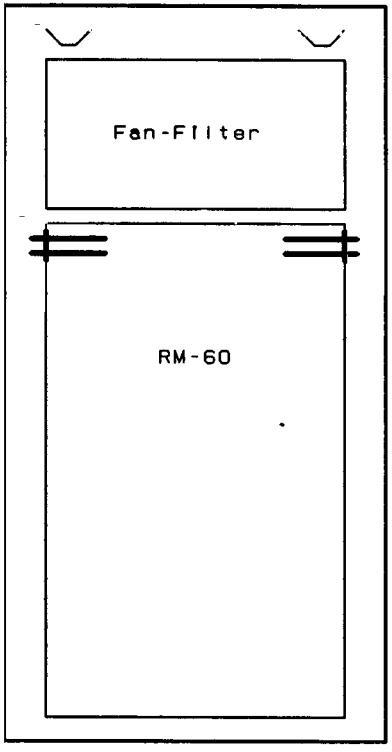
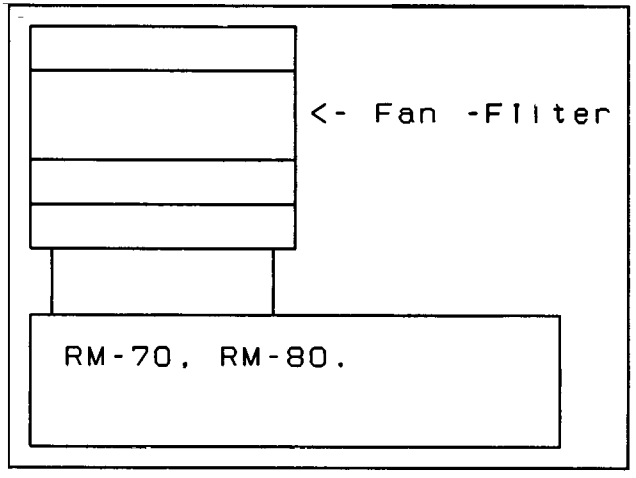


The fan filter assembly includes:

1. Plastic fan guard with three guard rings to mount on top of fan.
2. 12 volt D.C. fan unit (13 CFM free air, 110 ma) with solid state circuitry (for brushless electronic commutation), stainless steel ball bearings, locked rotor & polarity protection.
3. Plastic spacer with no guard rings, to act as plenum.
4. Filter assembly composed of three pieces:
    A. Plastic guard insert which holds filter element in place.
    B. Filter element.
    C. Plastic guard (one guard ring with no guard ring extension legs).

5. Plastic guard with one guard ring and four guard ring extension legs to act as spacer for use with the RM-60 or RM-70. Not used with the RM-80.
6. 16 fender washers (4 per bolt) to act as position locators for use with RM-60 and RM-70 and to act as spacers for use with RM-80.
7. Four bolts with finger nuts.
8. 100 ppi Polyurethane filters (5 replacement filters).
9. Velcro strap to hold fan over RM unit's window.
10. Regulated 12 volt power supply (200 ma). (Outside conductor positive, inside (tip) conductor negative). The power supply (Stancor) is regulated so that variations in A.C. line voltage will not influence fan speed. If you purchased the Fan-Filter without power supply, connect the Fan's red lead to the positve terminal and the black lead to the negative terminal of a 12 Volt DC 125 to 200 ma power supply. It is best to use a "regulated" power supply.





To mount fan-filter:

1. Assembly the fan-filter unit as per the diagrams. First slide the washers onto bolts then RM-60,70 plastic guard spacer (omit this piece for RM-80 use), followed by filter, plenum spacer, fan, guard, finger nuts. As per the first diagram, for use with the RM-60 or RM-80, push washers and bolt heads apart as you tighten finger nuts, so that washers will clear RM-60 body and bolt heads will clear RM-80 cap. For use with the RM-70, push washers and bolt heads together as you tighten finger nuts, to act as locators on side of RM-70 cap.

2. Place fan-filter unit over the RM unit's window, with filter side towards window. Position fan-filter such that RM unit's window has a clean shot at the filter element. On the RM-60, the Fan-Filter can be positioned on top of the RM-60, with fan-filter sides in the same plane as RM-60

sides. In this case, even though the RM-60 window will not be exactly centered underneath the filter element, this has no effect on sensitivity.

3. Use Velcro strap to hold fan-filter in place, by wrapping Velcro strap around fan-filter and body of RM unit. Position strap buckle over fan exit guard. Don't over tighten strap particularly when strapping to the RM-70. Since the air flow of the fan is very small, the Velcro strap will not alter it.

Note: The Fan contains stainless steel ball bearings. During the first few hours of operation, the bearings may be a little noisy as they break in.

Although the workings of Radon and Radon daughters may seem somewhat technical at first, after you experiment, it should become more familiar.

About radiation units: Strictly speaking, units of radiation expressed in the form of roentgen or micro roentgen per hour relate to X-rays and Gamma rays. Alpha and Beta particles from Radium B, Radium C and Po-214 generate the vast majority of counts from the filter. In this case, a more applicable terminology is expression of particle flux in counts per unit time, for example, CPM (counts per minute). For those who prefer a count per unit TBU, set calibration factor to 100 for the TBU in question, as indicated in the RM-60 manual and AW-GRAPH manual. It is suggested that when collecting data, use the 60 second TBU.

First read the MAKDECAY manual for an understanding of Radon daughters, etc.

Place the unit in the suspected Radon infested area, on a chair, table, etc., and plug the RM unit into your computer. You can position the RM-fan-filter assembly using any convenient orientation, that is with the fan blowing up, down or sideways. The particular orientation you use will have little effect on the performance of the unit, even when oriented such that the fan is facing down, with the finger nuts acting as legs, due to the slow air flow rate, which is on the order of a few CFM. (When using the Fan-Filter with an RM-60, if you decide to place the unit such that the finger nuts act as legs, you can reverse the RM-60 cover such that the printing on the cover will appear right side up. Just remove the four screws from the RM-60 cover, reverse the cover, then re-install the screws).

Note: To decrease the background count rate slightly you can orient the RM unit such that the tube will present the least tube surface area to the heavens and thereby intercept less Cosmic particles as follows: RM-60 positioned such that the fan is blowing up or down instead of sideways. RM-70 or RM-80 positioned such that the fan is blowing sideways.

Begin saving radiation data to a file using a TBU of 60 seconds (see RM-60 manual). Start the fan by plugging it in. If there is any Radon present, you will notice an increase in the rate of ionization (count rate) detected by the RM unit. This will build up for several hours, after which the filter will reach equilibrium with the Radon daughters in the atmosphere. It is these same daughters that can collect in your lungs.

Once the Fan-Filter has reached equilibrium, the plot will be directly related, in a linear fashion, to Radon levels. This is due to the fact that the Radium B & C daughters are continually decaying into Pb-210, which is 427,000 times less radioactive than Radium B & C, (the radioactivity of a material is directly related to its halflife) so the contribution to count rate by Pb-210 buildup will be lost in the background count rate.

If you then turn off the fan, you will see the count rate decay, with a halflife of approx. 40 minutes. This is due to the decay of the Pb-214 (Radium B) with a halflife of approx. 27 minutes into Bi-214 (Radium C) with a halflife of approx. 20 mins., which decays into radioactive lead, Pb-210, with a halflife of 22.26 years. As indicated above, the activity of a material is directly related to the halflife. Since the halflife of PB-210 is so much longer than Pb-214 and Bi-214, once they decay away, you can re-use the filter, even though it will contain PB-210. This is also why the fan-filter can be used to track the varying levels of Radon, real time, with the fan running.

Once equilibrium is reached, the Fan - Filter - RM-60 combination should generate an increase over background count rate of approximately 5 to 10 counts per minute per pico curie Radon per liter air. Since the RM-70 and RM-80 are equipped with a larger alpha-beta window, they will generate a much larger count per minute reading as compared to the RM-60. (RM-70: 50 to 100 CPM per pico curie Radon / liter air, RM-80: 120 to 240 CPM per pico curie Radon / liter air). *(Note: EPA's action levels equate 1 picocurie Radon / liter air with 0.005 Working Level (WL)).*

It is recommended you use AW-GRAPH to view the data. If you do, you might find it convenient to have AW-GRAPH average together perhaps 10 to 60 minutes of data per point displayed. For example, when gathering data, use a TBU of 60 secs. and when prompted by AW-GRAPH for a compression value, enter 10 or 60, and a calibration factor, enter 100. Some of the graphs at our web site (www.aw-el.com) compress 6 hours (360 minutes) of data per point displayed

The filter should last many months, after which you can wash it off or replace it. We have used a filter for over half a year, in a dirty environment. The filter became quite dirty looking, but when we replaced it, the new filter gave the exact same reading as the old filter. To remove the filter for washing or replacement, remove the four finger nuts and pull off the fan - filter assembly. Next pull off the filter unit and open the holder by prying carefully with a knife or screw driver. Replace the filter and re-install.

To empirically (experimentally) calibrate the fan - filter combination carry out the following: First purchase a 2 to 4 day Radon test kit from your hardware store, such as a First Alert Radon test kit (or purchase a Radon Test Kit from Aware Electronics $10). After observing your area, as above, for several days, you will notice changes in level when opening a window, from day to night, etc. Choose a time when the area will remain undisturbed for at least 2 to 4 days, except for normal entry / exit. Start up the fan and begin collecting data as above. After reaching equilibrium, as above, start the Radon test kit. Run for two to four days, then return the Radon test kit for analyses. (If shipping overseas, use an express mail service). Save the file for review, take an average of the file, and note the increase over background. Compare this to the results of the Radon test and calibrate accordingly. Future variation in radiation from the filter will relate

linearly with your calibration. For example if you measured a 20 count per minute average increase from the filter and your Radon test result indicated 2 pico curies per liter air, then you know that for every increase of 10 CPM, an increase of one pico curie Radon per liter air is indicated. To smooth out minute by minute variations in reading, try reviewing with 10 or twenty minutes of data averaged per point. Also see "EXPORTING ASCII FILES FROM AW-SRAD.EXE" in the AW-GRAPH manual. (Note: 1 pico curie per liter air equals 37 Becquerel per cubic meter).

If you observe the decay curve of Radon Daughters collected with an Aware Fan-Filter, after turning off the fan, using AW-GRAPH (or a spreadsheet program), you will notice what appears to be a curve with a halflife of approx. 40 minutes. This is due to the following:

The two materials generating a flux from the filter are Radium B (halflife 26.8 minutes) and Radium C (halflife 19.9 minutes), both beta emitters. Radium B decays into Radium C, resulting in a curve with an apparent halflife of approx. 40 minutes.

You can verify this by using the MAKDECAY program with AW-GRAPH (see MAKDECAY manual) or use a spread sheet program to plot the decay curve of Radium B and Radium C as follows.

Given a certain quantity of radioactive material, if you know the halflife, you can calculate the remaining quantity of the material after a period of time using the following formula:

$$E = E_0 * e^{-(\text{DecayConstant} * t)}$$

Where E = the remaining material,
E_0 = the initial quantity,
e = Natural Log Number, i.e. 2.71828,
DecayConstant = 1/(halflife * 1.443),
t = elapsed time expressed in units the same as the halflife.

Fill four columns in the spreadsheet as follows. Fill column 1 with time numbers (for example 0 1 2 3 4 5 6 etc.) for the x-axis.

Fill column two with the remaining quantity of Radium B using the corresponding time number in column 1 and the Decay Constant of Radium B, by applying the above formula. Start with an arbitrary amount of Radium B, say 1000 units.

Fill column three with the remaining quantity of Radium C as above, starting with an arbitrary amount of Radium C, say 700 units, but for every row, add to the starting amount, the quantity of Radium B lost in the corresponding row of column 2. Fill column 4 with the sum of column 2 and 3.

Now generate a graph by assigning column 1 to the x-axis and column four to the y-axis. You should get a curve with an apparent decay very similar to what you observe with real data when

plotting Radon daughter decay.

It is likely the Fan-Filter is collecting a little Thorium daughter as well. This would be Pb-212. You can add a col. 5, col. 6 and col. 7. to the spreadsheet. Fill col. 5 with decay info for Pb-212 (halflife: 10.64 hours), using the above formula and the time info in Col. 1. Pb-212 is a daughter of Rn-220 (gaseous Radon isotope from Thorium, with halflife of 55.6 secs.). Fill col. 6 with the sum of col. 4 and 5. and add col. 6 to a y-axis graph series. Import into col. 7 actual data collected from the fan-filter, and add this to a y-axis graph series as well. Make sure the time increment in col. 1 equals the time increment of the imported data in col. 7. Now observe the graph then adjust the starting quantity of Ra B&C and Pb-212 so that col. 6 curve matches col. 7 curve. This will reveal the percentage of Pb-212 collecting on the filter.

If you have any questions, phone or write us.

The following pages are screen dumps from the program RADDECAY.EXE, a freeware program which you can download from the USERS page at our world wide web site http:\\www.aw-el.com.

Rn-222 ——^P Po-218 ——^P Pb-214 ——^P Bi-214 ——^P Po-214

Result of decaying 1 curie of Rn-222 for 1 hour

Nuclide	halflife	branching from parent	fraction	curies
Rn-222	38.235e-01 Days	[parent]	9.9247e-001	9.925e-001
Po-218	3.050e+00 Minutes	1.0000	9.9302e-001	9.930e-001
Pb-214	2.680e+01 Minutes	.9998	7.5749e-001	7.575e-001
Bi-214	1.990e+01 Minutes	1.0000	4.9117e-001	4.912e-001
Po-214	6.370e-05 Seconds	.9998	4.9107e-001	4.911e-001

Po-218
(Polonium)

Atomic number : 84
Element weight: 210
Halflife : 3.05 minutes
Daughter : Pb-214
Branch ratio : .9998

Record files info retrieval:

	Number of records	press key
Alphas :	2	[A]
Betas :	0	[B]
Positrons:	0	[P]
Electrons:	0	[E]
Gammas :	0	[G]

(and X rays)

Return to names list [Esc]

Alphas

	probability per decay	energy (MEV)
1	.999790	6.002500
2	.000011	5.181000

Pb-214
(Lead)

Atomic number : 82
Element weight: 207.19
Halflife : 26.8 minutes
Daughter : Bi-214
Branch ratio : 1

Record files info retrieval:

	Number of records	press key
Alphas :	0	[A]
Betas :	5	[B]
Positrons:	0	[P]
Electrons:	17	[E]
Gammas :	18	[G]

(and X rays)

Return to names list [Esc]

Betas

	probability per decay	maximum (MEV)	average (MEV)
1	.025500	.184940	.050000
2	.008300	.490460	.145000
3	.480000	.672080	.207000
4	.425000	.728800	.227000
5	.063000	1.024000	.337000

Electrons

	probability per decay	energy (MEV)
1	.186500	.008150
2	.106790	.036839
3	.025093	.049227
4	.008446	.052288
5	.006827	.058200
6	.052889	.151460
7	.001879	.168260
8	.074676	.204690
9	.009214	.225590
10	.002899	.237980
11	.090792	.261400
12	.013357	.278830
13	.003156	.291210
14	.001051	.294270
15	.016000	.335530
16	.003758	.347920
17	.001250	.350980

Gammas & X-rays

	probability per decay	energy (MEV)
1	.135050	.010800
2	.011054	.053226
3	.062130	.074815
4	.104600	.077108
5	.046683	.087300
6	.074913	.241980
7	.005527	.258790
8	.003257	.274530
9	.192470	.295210
10	.372100	.351920
11	.001678	.462100
12	.003395	.480420
13	.004412	.487080
14	.001905	.533690
15	.003652	.580150
16	.010956	.785910
17	.005892	.839020
18	.003267	.280680

Bi-214
(Bismuth)

Atomic number : 83
Element weight: 208.98
Halflife : 19.9 minutes
Daughter : Po-214
Branch ratio : .99979

Record files info retrieval:

	Number of records	press key
Alphas :	0	[A]
Betas :	31	[B]
Positrons:	0	[P]
Electrons:	6	[E]
Gammas : (and X rays)	56	[G]

Return to names list [Esc]

Betas

	probability per decay	maximum (MEV)	average (MEV)
1	.004100	.541410	.162000
2	.002110	.550760	.165000
3	.001180	.575300	.173000
4	.001100	.761800	.239000
5	.002050	.764390	.240000
6	.010700	.787570	.248000
7	.028100	.822270	.261000
8	.005600	.976680	.318000
9	.001400	1.003300	.328000
10	.003360	1.061400	.350000
11	.056100	1.065700	.352000
12	.008900	1.077400	.357000
13	.004300	1.122200	.374000
14	.044300	1.151400	.385000
15	.001440	1.181500	.397000
16	.025000	1.252700	.425000
17	.015000	1.259200	.427000
18	.011900	1.275400	.434000
19	.015900	1.379700	.475000
20	.083400	1.422600	.492000
21	.177000	1.505500	.525000
22	.002560	1.527000	.534000
23	.179000	1.540400	.539000
24	.008800	1.608800	.567000
25	.033800	1.726600	.615000
26	.010100	1.854500	.668000
27	.078600	1.892300	.684000
28	.002200	1.995200	.726000
29	.006000	2.660700	1.007000
30	.172000	3.270000	1.269000
31	.003616	.526000	.158590

Po-214
(Polonium)

Atomic number : 84
Element weight: 210
Halflife : 6.37e-5 seconds
Daughter : Pb-210
Branch ratio : 1

Record files info retrieval:

	Number of records	press key
Alphas :	2	[A]
Betas :	0	[B]
Positrons:	0	[P]
Electrons:	0	[E]
Gammas : (and X rays)	1	[G]

Return to names list [Esc]

Alphas

	probability per decay	energy (MEV)
1	.999890	7.687100
2	.000106	6.892400

Po-214 ——————^P Pb-210 ——————^P Bi-210 ——————^P Po-210 ——^P stable

Result of decaying 1 curie of Po-214 for 365 days.

Nuclide	halflife	branching from parent	fraction	curies
Po-214	63.700e-06 Seconds	[parent]	0.0000e+000	0.000e+000
Pb-210	2.226e+01 Years	1.0000	8.7901e-014	8.790e-014
Bi-210	5.013e+00 Days	1.0000	8.7956e-014	8.796e-014
Po-210	1.384e+02 Days	1.0000	7.4098e-014	7.410e-014

Pb-210
(Lead)

Atomic number : 82
Element weight: 207.19
Halflife : 22.26 years
Daughter : Bi-210
Branch ratio : 1

Record files info retrieval:

	Number of records	press key
Alphas :	0	[A]
Betas :	2	[B]
Positrons:	0	[P]
Electrons:	3	[E]
Gammas : (and X rays)	2	[G]

Betas

	probability per decay	maximum (MEV)	average (MEV)
1	.802000	.016498	.004140
2	.198000	.063001	.016130

Electrons

	probability per decay	energy (MEV)
1	.335910	.008150
2	.579150	.030116
3	.181040	.042504

Gammas & X-rays

	probability per decay	energy (MEV)
1	.243240	.010800
2	.040500	.046503

INSTALLATION AND OPERATION

Threaded holes on the bottom and one side surface may be used for mounting, or the supply may be rear mounted using the same holes that attach the rear cover plate. An accessory Mounting Kit (model NP6) is available to enable mounting the power supply when the opposite side of the mounting surface is inaccessible.

Even a relatively small amount of air flowing around and through a power supply will significantly reduce the rise in its temperature resulting from operation, and therefore the temperature of the critical components within it, improving both reliability and stability. Avoid blocking air flow through vented surfaces. If the perforated bottom of a supply is mounted to a solid surface, use spacers at least 3/16" thick between it and the surface to which it is fastened, to permit convection air flow, or punch ventilation holes in the mounting surface. Allow free air to circulate around heat sinks. Space at least one inch away from surrounding objects.

Make all connections before applying AC input power.

THE SENSING TERMINALS MUST BE CONNECTED to the output terminals, either at the barrier strip on the power supply or at the load. Failure to have the sense terminals connected will affect the output voltage (usually causing it to be higher than the rating of the supply, and unadjustable), and may result in permanent damage to both the power supply and its load. If voltage drops in the output voltage leads (which degrade regulation) are not objectionable, local sensing can be used; leave in place the jumpers provided with the power supply on the barrier strip (connecting the $^{+}$SENS to the $^{+}$OUT terminal and the $^{-}$SENS to the $^{-}$OUT terminal). However, if the best possible regulation at the load is required, then remove the jumpers and use two additional leads to connect the sense terminals to the output leads at the load, as shown in the schematic. This configuration permits the power supply to sense and compensate the voltage actually across the load. Note that remote sensing is capable of compensating only limited wiring drops. The voltage across the load, plus the voltage drops through the wiring, must be within the output voltage range of the supply for the voltage at the load to remain within the load regulation specification.

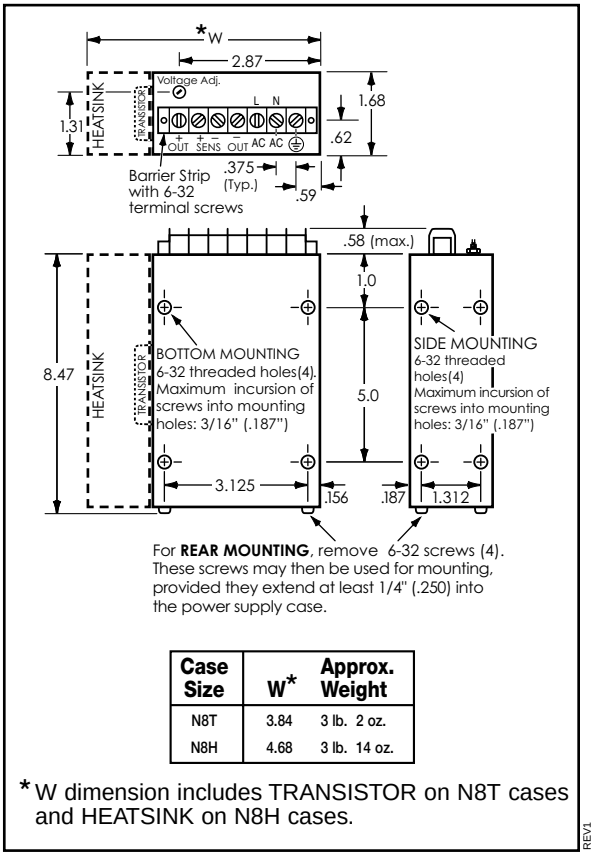
If there is any possibility of voltage from another source (another power supply, a battery, transients, etc) being applied to the power supply's output terminals, protect the power supply by using a diode in series with one of the output leads.

Do not attempt to directly parallel the outputs of two power supplies. This would result in current flowing from the higher-set output into the lower-set output, and probable damage to both circuits. Outputs may be connected in series to obtain a higher voltage provided that a reverse-biased diode, having PIV and current ratings exceeding the combined output, is used across each output; however, keep in mind that the output current to be drawn cannot exceed the output current rating of the lowest rated supply used.

Frequent fuse failure is symptomatic of power supply overload, a short circuited output, a tripped overvoltage protector, or power supply failure. Do not overfuse; this can result in damage to the power supply.

If the AC input power contains large voltage spikes ('noise') induced by the switching of high currents, inductive loads, electro-mechanical components, etc., the input power leads to the supply should include some means of transient suppression. Otherwise, a portion of the noise may be coupled through the supply to the load. Also, the supply could be damaged. The means of suppression that is easiest to install is a 1 mfd capacitor or a metal oxide surge suppressor (MOV) across the AC input terminals of the supply. In extremely severe cases, the use of RF chokes in series with each side of the line may also be required.

These power supplies operate as constant voltage sources when used at load current equal to or less than their ratings. If the power supply is overloaded, the current limit circuit will automatically reduce the output voltage, and it will then attempt to recover to its normal operating point. Therefore, A TRANSITORY OVERLOAD RESULTS IN A MOMENTARY DROP IN OUTPUT VOLTAGE. However, if the overload is still present when the voltage attempts to recover, the voltage will continue to alternately drop and recover, which will appear as a sawtooth oscillation of the output. Do not operate the power supply in this mode; reduce the load so that an output current equal to or less than the rating of the supply will be drawn.



Case Size	W*	Approx. Weight
N8T	3.84	3 lb. 2 oz.
N8H	4.68	3 lb. 14 oz.

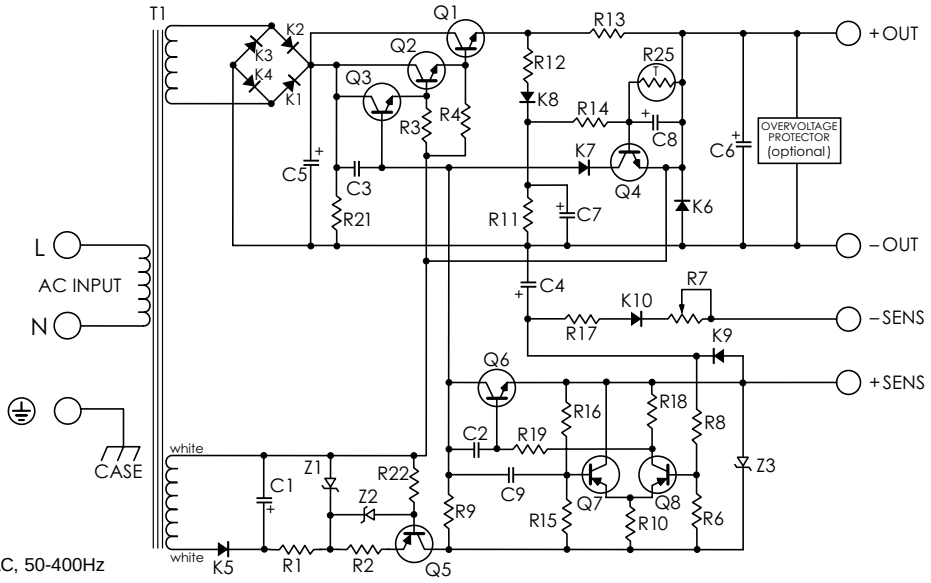
*W dimension includes TRANSISTOR on N8T cases and HEATSINK on N8H cases.

REV1

ALL ACOPIAN POWER SUPPLIES MADE IN U.S.A.

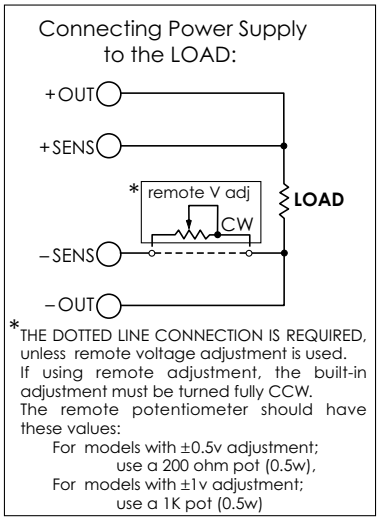
POWER SUPPLIES - NARROW PROFILE, Series A

Acopian modular power supplies are ideally suited to all applications where compact, high performance and high reliability power supplies are required. Modular construction and barrier strip interconnections provide mounting and wiring convenience and flexibility. All models have floating outputs which may be used floating, with either the positive or negative side grounded, and/or in series with another supply(ies). All have built-in short circuit protection and provision for remote sensing of output voltage at the load for applications where voltage regulation is critical. They are conservatively rated for operation at ambient temperatures to +71°C.



105 -125 VAC, 50-400Hz
(Standard)

210-250 VAC, 50-400Hz
(When model number ends in -230)



*THE DOTTED LINE CONNECTION IS REQUIRED, unless remote voltage adjustment is used. If using remote adjustment, the built-in adjustment must be turned fully CCW. The remote potentiometer should have these values:
For models with ±0.5v adjustment; use a 200 ohm pot (0.5w),
For models with ±1v adjustment; use a 1K pot (0.5w)

The MODEL NUMBER indicates any included options;
prefix V: overvoltage protection
suffix F: fungus proofing
suffix M: terminal strip cover
suffix –230: 230v input

CAUTION: To provide protection from risk of fire, include in the AC input wiring a 250V time-delay fuse with the amp rating listed below: (These fuse ratings are for 115V input models only; contact factory for fuse ratings for 230V input models.)

MODEL	Fuse size
A1NT220	3/8
A1NT350	6/10
A1.5NT220	3/8
A1.5NT350	6/10
A2NT220	3/8
A2NT300	1/2
A3NT220	4/10
A3NT350	7/10
A3.3NT220	4/10
A3.3NT350	7/10
A5TN110	3/10
A5NT220	1/2
A5NT350	8/10
A6NT220	1/2
A6NT270	6/10
A7TN110	3/10
A7NT200	1/2
A8TN110	3/8
A8NT200	1/2
A9TN110	3/8
A9NT200	6/10

MODEL	Fuse size
A10TN110	3/8
A10NT200	7/10
A11TN110	3/8
A11NT200	7/10
A12TN110	1/2
A12NT200	7/10
A13TN110	1/2
A13NT200	8/10
A14TN110	1/2
A14NT200	8/10
A15TN110	1/2
A15NT200	8/10
A16TN100	4/10
A16NT175	8/10
A18TN100	1/2
A18NT150	8/10
A20TN90	1/2
A20NT125	7/10
A24TN100	6/10
A24NT125	7/10
A25TN75	1/2

MODEL	Fuse size
A25NT125	8/10
A26NT125	8/10
A28NT80	6/10
A28NT125	8/10
A30NT75	6/10
A30NT110	8/10
A32TN60	1/2
A34NT110	1
A35TN60	6/10
A35NT110	1
A36TN60	6/10
A36NT100	1
A40NT75	7/10
A45NT60	7/10
A48NT50	6/10
A50NT45	6/10
A55NT40	6/10
A60NT35	1/2
A65NT27	3/8
A70NT25	1/2
A75NT25	1/2
A80NT25	1/2

MODEL	Fuse size
A85NT25	6/10
A90NT25	1/2
A95NT20	1/2
A100NT20	1/2
A120NT20	6/10
A125NT20	6/10
A150NT10	3/8